The present invention relates to the specific use of fungicidal combinations comprising (a) bixafen and (b) tebu-conazole for increasing the tolerance of a plant species from the family of true grasses (Poaceae) towards at least one abiotic stress factor. In particular, the present invention relates to the specific use of fungicidal combinations comprising (a) bixafen and (b) tebu-conazole for increasing the tolerance of a plant species from the family of true grasses (Poaceae) towards at least one abiotic stress factor, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an increased yield and/or an improved physiological condition of the plant.
Use of fungicidal combinations for increasing the tolerance of a plant towards abiotic stress

The present invention relates to the specific use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of the true grasses (*Poaceae*) towards at least one abiotic stress factor.

The present invention relates more particularly to the specific use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of true grasses (*Poaceae*) towards at least one abiotic stress factor, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an increased yield.

The present invention further relates to the specific use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of true grasses (*Poaceae*) towards at least one abiotic stress factor, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an improved physiological condition of the plant.

The invention further relates to a method for treating a plant species or parts of this plant species from the family of the true grasses (*Poaceae*) for increasing the tolerance to at least one abiotic stress factor and to a method for increasing the tolerance of seed and germinating plants to abiotic stress factors by treating the plants or parts of the plants or seed or germinating plants with a fungicidal combination comprising (a) bixafen and (b) tebuconazole.

Biotic and abiotic causes have to be differentiated as possible causes of damage to plants. Most biotic causes of damage to plants are known pathogens, which can be controlled by chemical crop protection measures and by tolerance breeding. In contrast, abiotic stress is the action of individual or combined environmental factors (in particular frost, cold, heat and drought) on the metabolism of the plant, which is an unusual stress on the organism. In this context, tolerance to abiotic stress means that plants are capable of enduring the stress situation with substantial retention of their performance or with less damage than is observed with corresponding, more stress-sensitive controls.

The action of moderate stress factors over relatively long periods of time or short-term extreme stress may lead to irreversible damage and even the death of the plants. To a considerable extent, abiotic stress factors are thus responsible for harvest losses or result in average harvests that are frequently significantly less than the maximum possible yield (Bray et al.: "Responses to Abiotic Stresses", in: Buchanan, Gruissem, Jones
It is known that chemical substances may increase the tolerance of plants to abiotic stress. Such effects, which are frequently also associated with increased yields, are also observed inter alia when certain fungicides are used and have been demonstrated for the group of the strobilurins (Bartlett et al., 2002, Pest Manag Sci 60: 309).

For some azole compounds, too, a stress tolerance-promoting action has already been shown. However, hitherto this has been limited to azoles of a particular type of structure (for example methylazoles); to azoles in combination with abscisic acid (ABA); to azoles causing a significant suppression of growth in the treated plants; to applications of the azoles in the treatment of seed or seedlings and to the reduction of damage caused by artificial gassing with ozone (see, for example, WO 2007/008580 A; Imperial Chemical Industries PLC, 1985, Research Disclosure 259: 578-582; CA 211 98 06; JP 2003/325063 A; Wu and von Tiedemann, 2002, Environmental Pollution 116: 37-47).

Furthermore, effects of growth regulators on the stress tolerance of crop plants have been described, including the methylazole paclobutrazole used as growth regulator (Morrison and Andrews, 1992, J Plant Growth Regui 11: 113-117; Imperial Chemical Industries PLC, 1985, Research Disclosure 259: 578-582).

The action of abscisic acid (ABA) as phytohormone has been described for a large number of physiological processes. Thus, ABA acts, for example, as a "stress hormone", the formation of which is induced inter alia by drought stress and mediates inter alia an inhibition of the stomatal transpiration (closure of the stomata) (Schopfer, Brennicke: "Pflanzenphysiologie" [Plant physiology], 5th edition, Springer, 1999). This makes the plant more tolerant to drought stress.

In numerous examples, it was shown that, by exogenous application of abscisic acid, it is possible to reduce the sensitivity of plants to stress, or to increase stress tolerance (Jones and Mansfield, 1970, J. Exp. Botany 21: 743-747; Bonham-Smith et al., 1988, Physiologia Plantarum 73: 27-30). Furthermore, it could also be shown that ABA-analogous structures, too, are capable of triggering ABA-like plant reactions (Churchill et al., 1998, Plant Growth Regui 25: 35-45; Huang et al., 2007, Plant J 50: 414-428). The stress tolerance-increasing action of ABA analogues in combination with growth inhibitors has likewise already been described (DC 38 215 20 A).

The European patent application No. EP 2168434 describes the use of azoles for reducing abiotic stress.

WO 2009/0982 18 A2 discloses a method for improving plant health by treatment of the plant with various SDH inhibitors and also with combinations of SDH inhibitors and other pesticides. The term plant health,
according to the definition in WO 2009/098218, encompasses the yield and the vitality of the plants and also the tolerance towards abiotic stress factors.

EP 2 039 771 A2 discloses a method for improving the production potential of transgenic plants, especially maize, through treatment with bixafen. One of the measures mentioned for improving the production potential of the plants is the tolerance of the plants towards abiotic stress. EP 2 039 771 A2 does not disclose any biological data demonstrating this effect.

WO 2005/018324 A2 discloses a method for boosting plant growth by means of amide compounds, such as boscalid, for example. Bixafen is not disclosed.

WO 2010/136139 A2 discloses the use of succinate dehydrogenase inhibitors, in particular bixafen, for increasing the tolerance of plants to abiotic stress factors.

WO 2011/095496 A2 discloses the specific use of succinate dehydrogenase (SDH) inhibitors in the treatment of plant species from the family of true grasses (Poaceae) for the purpose of increasing the biomass of the plant. More specifically disclosed is the use of bixafen alone or in combination with spiroxamine, fluoxastrobin or prothioconazole.

The actions described in the prior art have to be considered as positive; however, in some cases they require improvement. In addition, for avoiding tolerances, it is desirable to provide alternative compounds for reducing abiotic stress.

Surprisingly, it has now been found that combinations comprising (a) bixafen and (b) tebuconazole increase the tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor.

Accordingly, the present invention relates to the specific use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor.

The present invention further relates to the specific use of fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for increasing the tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor. The present invention further relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole.
The present invention further relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders.

The present invention further relates to a method for increasing the tolerance of seed and germinating plants to abiotic stress factors by treating the seed with a fungicidal combination comprising (a) bixafen and (b) tebuconazole.

The present invention further relates to a method for increasing the tolerance of seed and germinating plants to abiotic stress factors by treating the seed with a fungicidal combination consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders.

It has further been found that this tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor is in particular exemplified by an increased yield and/or an improved physiological condition of the plant.

The present invention therefore relates more particularly to the specific use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of true grasses (Poaceae) towards at least one abiotic stress factor, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an increased yield.

The present invention also relates to the specific use of fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for increasing the tolerance of a plant species from the family of true grasses (Poaceae) towards at least one abiotic stress factor, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an increased yield.

The present invention further relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an increased yield.

The present invention further relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination consisting of (a) bixafen and (b) tebuconazole as
fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an increased yield.

The present invention further relates more particularly to the specific use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of true grasses (Poaceae) towards at least one abiotic stress factor, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an improved physiological condition of the plant.

The present invention further relates more particularly to the specific use of fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for increasing the tolerance of a plant species from the family of true grasses (Poaceae) towards at least one abiotic stress factor, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an improved physiological condition of the plant.

The present invention further relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an improved physiological condition of the plant.

The present invention further relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an improved physiological condition of the plant.

None of the above mentioned documents from the prior art discloses or suggests the specific use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor. Furthermore, none of the above mentioned documents discloses the specific use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of true grasses (Poaceae) towards at least one abiotic stress factor, where that increased tolerance of the plant towards the at least one stress factor is exemplified by an increased yield and/or an improved physiological condition of the plant.
Within the meaning of the present invention, abiotic stress factors include drought, cold temperature exposure, heat exposure, osmotic stress, waterlogging, increased soil salinity, increased concentration of minerals, exposure to ozone, exposure to strong light, limited availability of nitrogen nutrients, and limited availability of phosphorus nutrients.

The present invention therefore also relates to the specific use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor, wherein the at least one abiotic stress factor is selected from the group consisting of drought, cold temperature exposure, heat exposure, osmotic stress, waterlogging, increased soil salinity, increased concentration of minerals, exposure to ozone, exposure to strong light, limited availability of nitrogen nutrients, and limited availability of phosphorus nutrients.

The present invention also relates to the specific use of fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for increasing the tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor, wherein the at least one abiotic stress factor is selected from the group consisting of drought, cold temperature exposure, heat exposure, osmotic stress, waterlogging, increased soil salinity, increased concentration of minerals, exposure to ozone, exposure to strong light, limited availability of nitrogen nutrients, and limited availability of phosphorus nutrients.

According to a preferred embodiment of the present invention, the at least one abiotic stress factor is selected from drought and heat exposure.

The present invention therefore also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, characterized in that the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, wherein the at least one abiotic stress factor is selected from the group consisting of drought, cold temperature exposure, heat exposure, osmotic stress, waterlogging, increased soil salinity, increased concentration of minerals, exposure to ozone, exposure to strong light, limited availability of nitrogen nutrients, and limited availability of phosphorus nutrients. According to a preferred embodiment of the present invention, the at least one abiotic stress factor is selected from drought and heat exposure.

The term tolerance towards abiotic stress is understood in the context of the present invention to encompass various kinds of advantages for plants that are not directly associated with the known fungicidal activity of fungicidal combinations comprising (a) bixafen and (b) tebuconazole. Such advantageous properties are manifested, for example, in the improved plant characteristics identified as follows: increased yield, increased number of ears per area, increased the grain yield per area, stabilization of the photosynthetic
efficiency, higher transpiration rate, lower leaf surface temperature, and delay in senescence, improved root
growth in terms of surface area and depth, increased tillering or stolonization, stronger and more productive
tillers and stolons, improvement in shoot growth, increased resistance to lodging, increased standing power,
increased shoot base diameters, increased leaf area, higher yields of nutrients and constituents, such as
chlorophylls, fats, oil, proteins, vitamins, minerals, essential oils, dyes, fibres, for example, better fibre
quality, earlier flowering, increased number of flowers, reduced level of toxic products such as mycotoxins,
reduced level of residues or disadvantageous constituents of any kind, or better digestibility, improved
stability of the harvested crop in storage, improved tolerance to inclement temperatures, improved tolerance
to drought and dryness, and also to lack of oxygen as a result of waterlogging, improved tolerance towards
increased salt levels in soils and water, increased tolerance towards ozone stress, improved tolerance to
herbicides and other plant treatment products, improved water uptake and photosynthesis rate, advantageous
plant properties, such as, for example, altered maturation, more uniform maturation, greater attraction for
beneficial organisms, improved pollination or other advantages which are well known to a person skilled in
the art.

Through the present invention, therefore, it is possible to more particularly increase the yield of the plant
species from the family of the true grasses (Poaceae). This may be ascertained by an increase in the number
of ears per area and the grain yield per area, as well as from the number of kernels per ear, the kernel weight
per ear, and the thousand kernel weight.

A further aspect of the present invention, therefore, the present invention relates to the use of fungicidal
combinations comprising (a) bixafen and (b) tebuconazole on plant species from the family of the true
grasses (Poaceae) for increasing the tolerance of the plant towards at least one stress factor, where this
tolerance is exemplified by an increased yield the yield of the plant, in particular by an increase in
the number of ears per area, the grain yield per area, the number of kernels per ear, the kernel weight per ear,
and the thousand kernel weight, most particularly for increasing the number of ears per area and the grain
yield per area.

A further aspect of the present invention, the present invention relates to the use of fungicidal
compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising
adjuvants, solvents, carrier, surfactants or extenders, on plant species from the family of the true grasses
(Poaceae) for increasing the tolerance of the plant towards at least one stress factor, where this tolerance is
exemplified by an increased yield the yield of the plant, in particular by an increase in the number of ears
per area, the grain yield per area, the number of kernels per ear, the kernel weight per ear, and the thousand
kernel weight, most particularly for increasing the number of ears per area and the grain yield per area.
The present invention also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, where this tolerance is exemplified by an increased yield the yield of the plant, in particular by an increase in the number of ears per area, the grain yield per area, the number of kernels per ear, the kernel weight per ear, and the thousand kernel weight, most particularly for increasing the number of ears per area and the grain yield per area.

Furthermore, in accordance with a further aspect, it has been found that the specific inventive application of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole on plant species from the family of the true grasses (Poaceae) is able not only to increase the yield of the treated plant but also to improve the physiological condition of the plant overall.

Improved plant physiology is manifested, for example, in a stabilization of the photosynthetic efficiency of the plant, a higher transpiration rate, a lower leaf surface temperature, and a delay in senescence. Accordingly, in the context of the present invention, it has been found that the specific inventive application of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole makes it possible to stabilize the photosynthetic efficiency of the plant, to induce a higher transpiration rate, a lower leaf surface temperature, and a delay in senescence. This delay of the senescence (maturation) of the plant, denotes to the farmer denotes an advantage on the basis of greater flexibility in the harvesting time. At the same time, the yellowing of such plants is likewise delayed.

Therefore, the present invention also relates to the use of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for application to plant species from the family of the true grasses (Poaceae) in order to improve the physiological condition of the plant, as exemplified by at least one feature selected from a stabilization of the photosynthetic efficiency, a higher transpiration rate, a lower leaf surface temperature, and delay in senescence.

The present invention also relates to the use of the fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for application to plant species from the family of the true grasses (Poaceae) in order to improve the physiological condition of the plant, as exemplified by at least one feature selected from a stabilization of the photosynthetic efficiency, a higher transpiration rate, a lower leaf surface temperature, and delay in senescence.

The present invention also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants
or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, where this tolerance is exemplified by at least one feature selected from a stabilization of the photosynthetic efficiency, a higher transpiration rate, a lower leaf surface temperature, and delay in senescence.

The present invention further relates to the use of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for application to plant species from the family of the true grasses (Poaceae) in order to improve the physiological condition of the plant, as exemplified for example by a stabilization of the photosynthetic efficiency, where that stabilization of the photosynthetic efficiency occurs at growth stage BBCH 77 and later.

The present invention further relates to the use of the fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for application to plant species from the family of the true grasses (Poaceae) in order to improve the physiological condition of the plant, as exemplified for example by a stabilization of the photosynthetic efficiency, where that stabilization of the photosynthetic efficiency occurs at growth stage BBCH 77 and later.

The present invention further relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, where this tolerance is exemplified by an improved physiological condition of the plant, for example by a stabilization of the photosynthetic efficiency, where that stabilization of the photosynthetic efficiency occurs at growth stage BBCH 77 and later.

The present invention further relates to the use of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for application to plant species from the family of the true grasses (Poaceae) in order to improve the physiological condition of the plant, as exemplified for example by a lower leaf surface temperature, where this lower leaf surface temperature occurs at growth stages BBCH 55 to 65, more preferably at growth stage BBCH 59.

The present invention further relates to the use of the fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for application to plant species from the family of the true grasses (Poaceae) in order to improve the physiological condition of the plant, as exemplified for example by a lower leaf surface temperature, where this lower leaf surface temperature occurs at growth stages BBCH 55 to 65, more preferably at growth stage BBCH 59.
The present invention further relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, where this tolerance is exemplified by an improved physiological condition of the plant, for example by a lower leaf surface temperature, where this lower leaf surface temperature occurs at growth stages BBCH 55 to 65, more preferably at growth stage BBCH 59.

In the context of the present invention it has additionally been found that through the specific inventive application of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole the chlorophyll content produced in the plant is increased. It has additionally been found that through the application of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole the chlorophyll content in the plant is stabilized. A stabilized chlorophyll content in the context of the present invention means that the breakdown of the chlorophyll in the plant is slower, owing to the inventive application, than in an untreated plant.

The present invention, accordingly, also relates to the use of at least one the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for application to plant species from the family of the true grasses (Poaceae) in order to achieve an increased chlorophyll content and/or a stabilized chlorophyll content in the plant.

The present invention, also relates to the use of at least one the fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for application to plant species from the family of the true grasses (Poaceae) in order to achieve an increased chlorophyll content and/or a stabilized chlorophyll content in the plant.

It has been ascertained, furthermore, that an increased photosynthesis rate may occur in the plants by virtue of the inventive application. The present invention therefore also relates to the use of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for application to plant species from the family of the true grasses (Poaceae) in order to achieve an increased photosynthesis rate in the plant.

The present invention also relates to the use of the fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for application to plant species from the family of the true grasses (Poaceae) in order to achieve an increased photosynthesis rate in the plant.

This increased photosynthesis rate of the plant may be accompanied by delayed senescence of the plant.

It has also been found that it is particularly advantageous to employ the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for the purpose of increasing the tolerance of a plant species from the
family of the true grasses (*Poaceae*) towards at least one abiotic stress factor in the development stages BBCH 12 to 70, preferably in the development stages BBCH 17 to 70, more preferably in the development stages BBCH 20 to 65, more preferably in the development stages BBCH 29 to 60, more preferably in the development stages BBCH 33 to 55, and most preferably in the development stages BBCH 33 to 49. As well as increasing the tolerance of the plant towards at least one abiotic stress factor, the fungicidal combinations comprising (a) bixafen and (b) tebuconazole proved at the same time to be effective in particular in increasing the yield and/or improving the physiological condition of the plants from the family of the true grasses (*Poaceae*).


If application of the fungicidal combination comprising (a) bixafen and (b) tebuconazole takes place at this point in time in the development of the plant, the increase of tolerance of the plant towards at least one abiotic stress factor, exemplified in particular by an increased yield and improved physiological condition of the plant, is particularly marked.

The present invention therefor also relates to the specific use of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for the purpose of increasing the tolerance of a plant species from the family of the true grasses (*Poaceae*) towards at least one abiotic stress factor, where the fungicidal combination is applied to the plant in the development stages BBCH 33 to 55, preferably in the development stages BBCH 33 to 49.

The present invention therefor also relates to the specific use of the fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for the purpose of increasing the tolerance of a plant species from the family of the true grasses (*Poaceae*) towards at least one abiotic stress factor, where the fungicidal combination is applied to the plant in the development stages BBCH 33 to 55, preferably in the development stages BBCH 33 to 49.

The present invention also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (*Poaceae*) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, and where the fungicidal combination is applied to the plant in the development stages BBCH 33 to 55, preferably in the development stages BBCH 33 to 49.
Preferred areas for the application of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance towards at least one abiotic stress factor are treatments of the soil, the stems and/or the leaves with the approved application rates.

Within the context of the present invention it has also been found that it is advantageous to apply the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for the purpose of increasing the tolerance of a plant species from the family of the true grasses (*Poaceae*) towards at least one abiotic stress factor, before the appearance of the at least one abiotic stress factor.

The present invention therefor also relates to the specific use of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for the purpose of increasing the tolerance of a plant species from the family of the true grasses (*Poaceae*) towards at least one abiotic stress factor, where the fungicidal combination is applied to the plant before the appearance of the at least one abiotic stress factor.

The present invention also relates to the specific use of the fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for the purpose of increasing the tolerance of a plant species from the family of the true grasses (*Poaceae*) towards at least one abiotic stress factor, where the fungicidal combination is applied to the plant before the appearance of the at least one abiotic stress factor.

The present invention therefor also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (*Poaceae*) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, where the fungicidal combination is applied to the plant before the appearance of the at least one abiotic stress factor.

For the purposes of the present invention, a plant to be treated is more particularly a plant from development stage BBCH 12 onwards, preferably from development stage BBCH 20, more preferably from development stage BBCH 29, and even more preferably from development stage BBCH 33.

The increase of tolerance of a plant species from the family of true grasses (*Poaceae*) towards at least one abiotic stress factor, exemplified in particular by an increased yield and improved physiological condition of the plant, that is achieved through the application of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole according to the invention is preferably not attributable to the known fungicidal activity of these combinations against phytopathogens; in particular, with the approach taken by the invention, an increase of tolerance towards at least one abiotic stress factor, exemplified in particular by an increased
yield and improved physiological condition of the plant, can be achieved even in the absence of phytopathogens.

In the context of the present invention it has been found, furthermore, that through the specific inventive application of the fungicidal combination comprising (a) bixafen and (b) tebuconazole, it is possible to improve the tolerance of plants towards at least one abiotic stress factor. Thus in the case of heat stress it is found that plants treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole exhibit a higher transpiration rate and lower leaf surface temperature, due to an improved evaporative cooling.

The above-described effects of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole may occur individually or else simultaneously and can be demonstrated typically with terms that have general validity. Examples of such terms include the designations set out as follows: phytotonic effect, resistance to stress factors, less plant stress, plant health, healthy plants, plant fitness, plant wellness, plant concept, vigour effect, stress shield, protective shield, crop health, crop health properties, crop health products, crop health management, crop health therapy, plant health, plant health properties, plant health products, plant health management, plant health therapy, greening effect, re-greening effect, freshness, or other terms which are well known to a person skilled in the art.

In the context of the present invention, a good effect on the tolerance to abiotic stress is understood as meaning, but not by limitation,

- at least a yield which is increased by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,

- at least a number of ears per area and grain yield per area which is increased by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,

- at least a stabilization of the photosynthetic efficiency of the plant which is improved by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,

- at least a higher transpiration rate which is increased by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,

- at least a lower leaf surface temperature which is lowered by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,

- at least a delay in senescence which is increased by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,
• at least an emergence which is improved by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,

• at least a root development which is improved by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,

• at least a shoot length which is increased by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,

• at least a leaf area which is increased by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,

• at least a photosynthetic rate which is improved by in general 5%, in particular 10%, especially preferably 15%, specifically 20%,

it being possible for the effects to manifest themselves individually or else in any combination of two or more effects.

The use according to the invention shows the advantages described in particular in spray application, in the treatment of seed and in drip and drench applications on plants and parts of plants or seed.

In one embodiment, for example, it may be intended to apply the fungicidal combinations comprising (a) bixafen and (b) tebuconazole provided by the invention by spray application to appropriate plants or parts of plants to be treated.

The use intended according to the invention of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole is preferably carried out using a dosage from 0.01 to 3 kg/ha, particularly preferably from 0.05 to 2 kg/ha, especially preferably from 0.1 to 1 kg/ha for each active ingredient.

The use intended according to the invention of the fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, is preferably carried out using a dosage from 0.01 to 3 kg/ha, particularly preferably from 0.05 to 2 kg/ha, especially preferably from 0.1 to 1 kg/ha for each active ingredient.

The present invention therefor also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, where a dosage from 0.01 to 3 kg/ha, particularly preferably from 0.05 to 2 kg/ha, especially preferably from 0.1 to 1 kg/ha for each active ingredient is used.
The present invention further relates to the use of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of the true grasses (*Poaceae*) towards at least one abiotic stress factor, where the ratio of (a) bixafen to (b) tebuconazole is from 20:1 to 1:20. More preferably, the ratio of (a) bixafen to (b) tebuconazole is from 1:1 to 1:5.

The present invention further relates to the use of the fungicidal compositions consisting of (a) bixafen and (b) tebuconazole as fungicidal compounds, further comprising adjuvants, solvents, carrier, surfactants or extenders, for increasing the tolerance of a plant species from the family of the true grasses (*Poaceae*) towards at least one abiotic stress factor, where the ratio of (a) bixafen to (b) tebuconazole is from 20:1 to 1:20. More preferably, the ratio of (a) bixafen to (b) tebuconazole is from 1:1 to 1:5.

The present invention therefor also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (*Poaceae*) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, where the ratio of (a) bixafen to (b) tebuconazole is from 20:1 to 1:20. More preferably, the ratio of (a) bixafen to (b) tebuconazole is from 1:1 to 1:5.

According to the invention and depending on their particular physical and/or chemical properties, of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole can be converted into the customary formulations, such as solutions, emulsions, suspensions, powders, foams, pastes, granules, aerosols, micro-encapsulations in polymeric substances and in coating compositions for seeds, and ULV cool and warm fogging formulations.

These formulations are produced in a known manner, for example by mixing the active compounds with extenders, that is, liquid solvents, liquefied gases under pressure, and/or solid carriers, optionally with the use of surfactants, that is emulsifiers and/or dispersants, and/or foam formers. If the extender used is water, it is also possible to employ, for example, organic solvents as auxiliary solvents. Essentially, suitable liquid solvents are: aromatics such as xylene, toluene or alkylnaphthaienes, chlorinated aromatics or chlorinated aliphatic hydrocarbons such as chlorobenzenes, chloroethylenes or methylene chloride, aliphatic hydrocarbons such as cyclohexane or paraffins, for example petroleum fractions, alcohols such as butanol or glycol and their ethers and esters, ketones such as acetone, methyl ethyl ketone, methyl isobutyl ketone or cyclohexanone, strongly polar solvents such as dimethylformamide or dimethyl sulphoxide, or else water. Liquefied gaseous extenders or carriers are to be understood as meaning liquids which are gaseous at standard temperature and under atmospheric pressure, for example aerosol propellants such as halogenated hydrocarbons, or else butane, propane, nitrogen and carbon dioxide. As solid carriers there are suitable: for example ground natural minerals such as kaolins, clays, talc, chalk, quartz, attapulgite, montmorillonite or diatomaceous earth, and ground synthetic minerals such as finely divided silica, alumina and silicates.
Suitable solid carriers for granules are: for example crushed and fractionated natural rocks such as calcite, pumice, marble, sepiolite, dolomite, and synthetic granules of inorganic and organic meals, and also granules of organic material such as sawdust, coconut shells, maize cobs and tobacco stalks. Suitable emulsifiers and/or foam formers are: for example nonionic and anionic emulsifiers, such as polyoxyethylene fatty acid esters, polyoxyethylene fatty alcohol ethers, for example alkylaryl polyglycol ethers, alkylsulphonates, alkyl sulphates, arylsulphonates, or else protein hydrolysates. Suitable dispersants are: for example lignosulphite waste liquors and methylcellulose.

Tackifiers such as carboxymethylcellulose and natural and synthetic polymers in the form of powders, granules or latices, such as gum arabic, polyvinyl alcohol and polyvinyl acetate, or else natural phospholipids such as cephalins and lecithins and synthetic phospholipids can be used in the formulations. Other possible additives are mineral and vegetable oils.

It is possible to use colourants such as inorganic pigments, for example iron oxide, titanium oxide and Prussian Blue, and organic dyestuffs such as alizarin dyestuffs, azo dyestuffs and metal phthalocyanine dyestuffs, and trace nutrients such as salts of iron, manganese, boron, copper, cobalt, molybdenum and zinc.

The formulations generally comprise between 0.1 and 95 per cent by weight of active compound, preferably between 0.5 and 90%.

The treatment of the seed of plants has been known for a long time and is the subject of continuous improvements. However, the treatment of seed entails a series of problems which cannot always be solved in a satisfactory manner. Thus, it is desirable to develop methods for protecting the seed and the germinating plant which dispense with, or at least reduce considerably, the additional application of crop protection products after planting or after emergence of the plants. It is furthermore desirable to optimize the amount of active compound employed in such a way as to provide optimum protection for the seed and the germinating plant from attack by phytopathogenic fungi and, in accordance with the present invention, increase the resistance of the plants to abiotic stress factors in a corresponding manner, but without damaging the plant itself by the active compound employed. In particular, methods for the treatment of seed should also take into consideration the intrinsic fungicidal properties or the abiotic stress resistance of transgenic plants in order to achieve optimum protection of the seed and also the germinating plant with a minimum of crop protection products being employed.

Accordingly, the present invention in particular also relates to a method for increasing the resistance of seed and germinating plants to abiotic stress factors by treating the seed with a fungicidal combination comprising (a) bixafen and (b) tebuconazole.
The invention also relates to the use of a fungicidal combination comprising (a) bixafen and (b) tebuconazole for the treatment of seed for increasing the resistance of the seed and the germination plant to abiotic stress factors.

It is one of the advantages of the present invention that, by virtue of the particular systemic properties of the fungicidal combination comprising (a) bixafen and (b) tebuconazole the treatment of the seed with a fungicidal combination comprising (a) bixafen and (b) tebuconazole improves not only the resistance of the seed itself to abiotic stress factors but also the resulting plants after emergence. In this manner, the immediate treatment of the crop at the time of sowing or shortly thereafter can be dispensed with.

The fungicidal combinations comprising (a) bixafen and (b) tebuconazole according to the invention can be present in their/its commercially available formulations and in the use forms, prepared from these formulations, as a combination with at least one further agrochemically active compound, selected from fungicides, insecticides, acaricides, nematicides, attractants, sterilizing agents, herbicides, safeners, bactericides, growth-regulating substances, biologicals, hormones, pheromones, active compounds with unknown or unspecific mechanisms of action, fertilizers and semiochemicals.

The present invention therefor also relates to the specific use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor, wherein the fungicidal combination is applied in combination with at least one further agrochemically active compound selected from the group of fungicides, insecticides, acaricides, nematicides, herbicides, safeners, bactericides, biologicals, hormones, pheromones, and active compounds with unknown or unspecific mechanisms of action.

The present invention also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, where the fungicidal combination is applied in combination with at least one further agrochemically active compound selected from the group of fungicides, insecticides, acaricides, nematicides, herbicides, safeners, bactericides, biologicals, hormones, pheromones, and active compounds with unknown or unspecific mechanisms of action.

According to a preferred embodiment of the present invention, the at least one further agrochemically active compound is selected from the group of triazole fungicides and succinate dehydrogenase (SDH) inhibitors.

In the context of the present invention the at least one further triazole may be selected from the group comprising azaconazole, bitertanol, bromuconazole, cyproconazole, diclobutrazol, difenoconazole,
diniconazole, diniconazole-M, epoxiconazole, etaconazole, fenbuconazole, fluquinconazole, flusilazole, flutriafol, furconazole, furconazole-cis, hexaconazole, imibenconazole, ipconazole, metconazole, myclobutanil, paclobutrazol, penconazole, propiconazole, prothioconazole, quinconazole, simeconazole, tetracnazol, triadimefon, triadimenol, tiritconazole, uniconazole, uniconazole-P, voriconazole, 1-(4-chlorophenyl)-2-(1H-1,2,4-triazol-1-yl)cycloheptanol.

In the context of the present invention the at least one further succinate dehydrogenase (SDH) inhibitor refers to a compound which is capable of inhibiting succinate dehydrogenase in phytopathogenic fungal organisms, also being known as complex II inhibitor. According to the present invention the at least one further SDH inhibitor may be selected from the group comprising fluopyram, penflufen, sedaxane, isopyrazam (comprising mixture of syn-epimeric racemate IRS.4S,9R.S and anti-epimeric racemate IRS.4S,9R.S, anti-epimeric racemate IRS.4S,9R.S, anti-epimeric enantiomer IRS.4S,9S, anti-epimeric enantiomer IRS.4R,9R, syn epimeric racemate IRS.4S,9R.S, syn-epimeric enantiomer IRS.4R,9S), penthiopyrad, furametpyr, boscalid, fluxapyroxad, N-[(2,4-dichlorophenyl)-1-methoxypropan-2-yl]-3-(difluoromethyl)-1-methyl-1H-pyrazole-4-carboxamide, N-[(2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl)-3-(difluoromethyl)-1-methyl-1H-pyrazol-4-carboxamide, N-[(1S,4R)-9-(dichloromethyl)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methyl-1H-pyrazol-4-carboxamide, N-[(IR,4S)-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methyl-1H-pyrazol-4-carboxamide, 3-(difluoromethyl)-1-methyl-N-[2-(1,2,3,3,3-hexafluoropropoxy)phenyl]-1-methyl-1H-pyrazoi-4-carboxamide, 3-(difluoromethyl)-1-methyl-N-[2-(1,2,3,3,3-hexafluoropropoxy)phenyl]-1-methyl-1H-pyrazoi-4-carboxamide, 3-(difluoromethyl)-1-methyl-N-[2-(3-Cl-1,1,2-trifluoroethoxy)phenyl]-1H-pyrazol-4-carboxamide, N-[(IR,4S)-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methyl-1H-pyrazoi-4-carboxamide, N-[(1S,4R)-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methyl-1H-pyrazoi-4-carboxamide, and N-[(IR,4S)-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methyl-1H-pyrazoi-4-carboxamide.

Preferably, the at least one further agrochemically active compound is selected from prothioconazole and fluopyram.

Therefore, the present invention also relates to the use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor, wherein the fungicidal combination is applied in
combination with at least one further agrochemically active compound selected from prothioconazole and fluopyram. Most preferably, the at least one further agrochemically active compound is prothioconazole.

The present invention also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, wherein the fungicidal combination is applied in combination with at least one further agrochemically active compound selected from prothioconazole and fluopyram.

It is likewise to be considered advantageous that the fungicidal combinations comprising (a) bixafen and (b) tebuconazole can be used in particular also for transgenic seed.

According to the invention, the fungicidal combinations comprising (a) bixafen and (b) tebuconazole are particularly suitable for protecting seed of plant species from the family of true grasses (Poaceae).

In the context of the present invention, the fungicidal combinations comprising (a) bixafen and (b) tebuconazole are applied on their own or in a suitable formulation to the seed. Preferably, the seed is treated in a state in which it is stable enough to avoid damage during treatment. In general, the seed may be treated at any point in time between harvest and sowing. The seed usually used has been separated from the plant and freed from cobs, shells, stalks, coats, hairs or the flesh of the fruits. Thus, it is possible to use, for example, seed which has been harvested, cleaned and dried to a moisture content of less than 15% by weight. Alternatively, it is also possible to use seed which, after drying, has been treated, for example, with water and then dried again.

When treating the seed, care must generally be taken that the amount of the fungicidal combination comprising (a) bixafen and (b) tebuconazole applied to the seed and/or the amount of further additives is chosen in such a way that the germination of the seed is not adversely affected, or that the resulting plant is not damaged. This must be borne in mind in particular in the case of active compounds which can have phytotoxic effects at certain application rates.

The fungicidal combinations comprising (a) bixafen and (b) tebuconazole can be applied directly, i.e. without containing any other components and undiluted. In general, it is preferred to apply the fungicidal combinations comprising (a) bixafen and (b) tebuconazole to the seed in the form of a suitable formulation. Suitable formulations and methods for the treatment of seed are known to the person skilled in the art and are described, for example, in the following documents: US 4,272,417 A, US 4,245,432 A, US 4,808,430 A, US 5,876,739 A, US 2003/0176428 A1, WO 2002/080675 A1, WO 2002/028186 A2.
The fungicidal combinations comprising (a) bixafen and (b) tebuconazole which can be used in accordance with the invention can be converted into the customary seed-dressing formulations, such as solutions, emulsions, suspensions, powders, foams, slurries or other coating compositions for seed, and also ULV formulations.

These formulations are prepared in a known manner, by mixing the active compounds or active compound combinations with customary additives such as, for example, customary extenders and also solvents or diluents, colourants, wetting agents, dispersants, emulsifiers, antifoams, preservatives, secondary thickeners, adhesives, gibberellins and also water.

Colourants which may be present in the seed-dressing formulations which can be used in accordance with the invention are all colourants which are customary for such purposes. In this context, not only pigments which are sparingly soluble in water, but also dyes which are soluble in water, may be used. Examples which may be mentioned are the colourants known by the names Rhodamin B, C.I. Pigment Red 112 and C.I. Solvent Red 1.

Suitable wetting agents which may be present in the seed-dressing formulations which can be used in accordance with the invention are all substances which promote wetting and which are conventionally used for the formulation of agrochemical active compounds. Preference is given to using alkynaphthalenesulphonates, such as diisopropyl- or diisobutynaphthalenesulphonates.

Suitable dispersants and/or emulsifiers which may be present in the seed-dressing formulations which can be used in accordance with the invention are all nonionic, anionic and cationic dispersants conventionally used for the formulation of agrochemical active compounds. Preference is given to using nonionic or anionic dispersants or mixtures of nonionic or anionic dispersants. Suitable nonionic dispersants which may be mentioned are, in particular, ethylene oxide/propylene oxide block polymers, alkylphenol polyglycol ethers and tristyrylphenol polyglycol ether, and their phosphated or sulphated derivatives. Suitable anionic dispersants are, in particular, lignosulphonates, polyacrylic acid salts and arylsulphonate/formaldehyde condensates.

Antifoams which may be present in the seed-dressing formulations which can be used in accordance with the invention are all foam-inhibiting substances conventionally used for the formulation of agrochemical active compounds. Silicone antifoams and magnesium stearate can preferably be used.

Preservatives which may be present in the seed-dressing formulations which can be used in accordance with the invention are all substances which can be employed for such purposes in agrochemical compositions. Dichlorophene and benzyl alcohol hemiformal may be mentioned by way of example.
Secondary thickeners which may be present in the seed-dressing formulations which can be used in accordance with the invention are all substances which can be employed for such purposes in agrochemical compositions. Cellulose derivatives, acrylic acid derivatives, xanthan, modified clays and finely divided silica are preferred.

Adhesives which may be present in the seed-dressing formulations which can be used in accordance with the invention are all customary binders which can be employed in seed-dressing products. Polyvinylpyrrolidone, polyvinyl acetate, polyvinyl alcohol and tylose may be mentioned as being preferred.

Gibberellins which can be present in the seed-dressing formulations which can be used in accordance with the invention are preferably the gibberellins A1, A3 (= gibberellic acid), A4 and A7; gibberellic acid is especially preferably used. The gibberellins are known (cf. R. Wegler "Chemie der Pflanzenschutz- und Schadlingsbekämpfungsmittel" [Chemistry of plant protection agents and pesticides], vol. 2, Springer Verlag, 1970, p. 401-412).

The seed-dressing formulations which can be used in accordance with the invention can be employed for the treatment of a wide range of seed, either directly or after previously having been diluted with water. Thus, the concentrates or the preparations obtainable therefrom by dilution with water may be used to dress the seed of cereals, such as wheat, barley, rye, oats, and triticale, and also the seed of maize, rice, oilseed rape, peas, beans, cotton, sunflowers, and beets, or else vegetable seed of any of a very wide variety of kinds. The seed dressing formulations which can be used according to the invention or their dilute preparations may also be used to dress seed of transgenic plants. In this context, additional synergistic effects may also occur as a result of the concerted action with the expression products.

All mixers which can conventionally be employed for the seed-dressing operation are suitable for treating seed with the seed-dressing formulations which can be used in accordance with the invention or with the preparations prepared therefrom by addition of water. Specifically, a procedure is followed during the seed-dressing operation in which the seed is placed into a mixer, the specific desired amount of seed-dressing formulations, either as such or after previously having been diluted with water, is added, and everything is mixed until the formulation is distributed uniformly on the seed. If appropriate, this is followed by a drying process.

The application rate of the seed-dressing formulations which can be used according to the invention may be varied within a relatively wide range. It depends on the respective content of the active compounds in the formulations and on the seed. The active compound combination application rates are generally between 0.001 and 50 g per kilogram of seed, preferably between 0.01 and 15 g per kilogram of seed.
In accordance with the invention, it has additionally been found that the application, to plants or to their environment, of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole in combination with at least one fertilizer is possible.

Fertilizers which can be employed in accordance with the invention together with the fungicidal combinations comprising (a) bixafen and (b) tebuconazole are generally organic and inorganic nitrogen-containing compounds such as, for example, ureas, urea/formaldehyde condensates, amino acids, ammonium salts and ammonium nitrates, potassium salts (preferably chlorides, sulphates, nitrates), salts of phosphoric acid and/or salts of phosphorous acid (preferably potassium salts and ammonium salts). In this context, particular mention may be made of the NPK fertilizers, i.e. fertilizers which contain nitrogen, phosphorus and potassium, calcium ammonium nitrate, i.e. fertilizers which additionally contain calcium, or ammonia nitrate sulphate (general formula (NH4)2SO4 NH4NO3), ammonium phosphate and ammonium sulphate. These fertilizers are generally known to the skilled worker, see also, for example, Ullmann's Encyclopedia of Industrial Chemistry, 5th Edition, Vol. A 10, pages 323 to 431, Verlagsgesellschaft, Weinheim, 1987.

The fertilizers may also contain salts of micronutrients (preferably calcium, sulphur, boron, manganese, magnesium, iron, boron, copper, zinc, molybdenum and cobalt) and phytohormones (for example vitamin B1 and indole-3-acetic acid) or mixtures of these. Fertilizers employed in accordance with the invention may also contain other salts such as monoammonium phosphate (MAP), diammonium phosphate (DAP), potassium sulphate, potassium chloride, magnesium sulphate. Suitable amounts of the secondary nutrients, or trace elements, are amounts of from 0.5 to 5% by weight, based on the totality of the fertilizer. Other possible ingredients are crop protection agents, insecticides or fungicides, growth regulators or mixtures of these. This will be explained in more detail further below.

The fertilizers can be employed for example in the form of powders, granules, prills or compactates. However, the fertilizers can also be employed in liquid form, dissolved in an aqueous medium. In this case, dilute aqueous ammonia may also be employed as nitrogen fertilizer. Further possible constituents of fertilizers are described for example in Ullmann's Encyclopedia of Industrial Chemistry, 5th edition, 1987, Vol. A 10, pages 363 to 401, DE-A 4128828, DE-A 1905834 and DE-A 19631764.

The general composition of the fertilizers which, within the scope of the present invention, may take the form of straight and/or compound fertilizers, for example composed of nitrogen, potassium or phosphorus, may vary within a wide range. In general, a content of from 1 to 30% by weight of nitrogen (preferably 5 to 20% by weight), from 1 to 20% by weight of potassium (preferably from 3 to 15% by weight) and a content of from 1 to 20% by weight of phosphorus (preferably from 3 to 10% by weight) is advantageous. The
microelement content is usually in the ppm order of magnitude, preferably in the order of magnitude of from 1 to 1000 ppm.

In the context of the present invention, the fertilizer and the fungicidal combinations comprising (a) bixafen and (b) tebuconazole may be applied simultaneously, i.e. synchronously. However, it is also possible first to employ the fertilizer and then the fungicidal combinations comprising (a) bixafen and (b) tebuconazole or first the fungicidal combinations comprising (a) bixafen and (b) tebuconazole and then the fertilizer. In the case of nonsynchronous application of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole and the fertilizer, the application within the scope of the present invention is, however, carried out in a functional context, in particular within a period of from in general 24 hours, preferably 18 hours, especially preferably 12 hours, specifically 6 hours, more specifically 4 hours, even more specifically within 2 hours. In very special embodiments of the present invention, the application of the fungicidal combinations comprising (a) bixafen and (b) tebuconazole provided according to the invention and of the fertilizer is carried out within a time frame of less than 1 hour, preferably less than 30 minutes, especially preferably less than 15 minutes.

The fungicidal combinations comprising (a) bixafen and (b) tebuconazole to be used in accordance with the invention, if appropriate in combination with fertilizers, can preferably be employed in plant species of the family of true grasses (Poaceae), including wheat, rye, barley, oats, millet, maize, rice, triticale, bamboo and sugarcane. The present invention is suitable, furthermore, for the treatment of winter cereal and spring cereal.

Therefore, the present invention also relates to the use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor, wherein the plant species of the family of true grasses (Poaceae) is selected from wheat, rye, barley, oats, millet, maize, rice, triticale, bamboo and sugarcane.

The present invention also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, wherein the plant species of the family of true grasses (Poaceae) is selected from wheat, rye, barley, oats, millet, maize, rice, triticale, bamboo and sugarcane.

The method according to the invention can therefore also be used in the treatment of genetically modified organisms (GMOs), e.g. plants or seeds. Genetically modified plants (or transgenic plants) are plants in which a heterologous gene has been stably integrated into the genome. The expression "heterologous gene" essentially means a gene which is provided or assembled outside the plant and when introduced in the
nuclear, chloroplastic or mitochondrial genome gives the transformed plant new or improved agronomic or other properties by expressing a protein or polypeptide of interest or by downregulating or silencing other gene(s) which are present in the plant (using for example antisense technology, cosuppression technology or RNAi technology [RNA interference]). A heterologous gene that is located in the genome is also called a transgene. A transgene that is defined by its specific presence in the plant genome is called a transformation or transgenic event.

Therefore, the present invention also relates to the use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of the true grasses (Poaceae) towards at least one abiotic stress factor, where the treated plant is transgenic.

The present invention also relates to a method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, wherein the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole, wherein the treated plant is transgenic.

Plants and plant varieties which are preferably treated according to the invention include all plants which have genetic material which imparts particularly advantageous, useful traits to these plants (whether obtained by breeding and/or biotechnological means).

Plants and plant varieties which may also be treated according to the invention are those plants which are resistant to one or more abiotic stress factors. Abiotic stress conditions may include, for example, drought, cold temperature exposure, heat exposure, osmotic stress, waterlogging, increased soil salinity, increased exposure to minerals, exposure to ozone, exposure to strong light, limited availability of nitrogen nutrients, limited availability of phosphorus nutrients or shade avoidance.

Plants and plant varieties which may also be treated according to the invention are those plants characterized by enhanced yield characteristics. Enhanced yield in said plants can be the result of, for example, improved plant physiology, improved plant growth and improved plant development, such as water use efficiency, water retention efficiency, improved nitrogen use, enhanced carbon assimilation, improved photosynthesis, increased germination efficiency and accelerated maturation. Yield can furthermore be affected by improved plant architecture (under stress and non-stress conditions), including early flowering, flowering control for hybrid seed production, seedling vigour, plant size, internode number and distance, root growth, seed size, fruit size, pod size, pod or ear number, seed number per pod or ear, seed mass, enhanced seed filling, reduced seed dispersal, reduced pod dehiscence and lodging resistance. Further yield traits include seed composition, such as carbohydrate content, protein content, oil content and composition, nutritional value, reduction in anti-nutritional compounds, improved processability and improved storage stability.
Plants that may likewise be treated according to the invention are hybrid plants that already express the characteristics of heterosis, or hybrid vigour, which results in generally higher yield, vigour, health and resistance towards biotic and abiotic stress factors. Such plants are typically made by crossing an inbred male-sterile parent line (the female parent) with another inbred male-fertile parent line (the male parent).

Hybrid seed is typically harvested from the male sterile plants and sold to growers. Male sterile plants can sometimes (e.g. in corn) be produced by detasseling (i.e. the mechanical removal of the male reproductive organs or male flowers) but, more typically, male sterility is the result of genetic determinants in the plant genome. In that case, and especially when seed is the desired product to be harvested from the hybrid plants, it is typically useful to ensure that male fertility in hybrid plants, which contain the genetic determinants responsible for male sterility, is fully restored. This can be accomplished by ensuring that the male parents have appropriate fertility restorer genes which are capable of restoring the male fertility in hybrid plants that contain the genetic determinants responsible for male sterility. Genetic determinants for male sterility may be located in the cytoplasm. Examples of cytoplasmic male sterility (CMS) were for instance described in Brassica species (WO 1992/005251, WO 1995/009910, WO 1998/27806, WO 2005/002324, WO 2006/021972 and US 6,229,072). However, genetic determinants for male sterility can also be located in the nuclear genome. Male sterile plants can also be obtained by plant biotechnology methods such as genetic engineering. A particularly useful means of obtaining male sterile plants is described in WO 89/10396 in which, for example, a ribonuclease such as a barnase is selectively expressed in the tapetum cells in the stamens. Fertility can then be restored by expression in the tapetum cells of a ribonuclease inhibitor such as barstar.

Plants or plant varieties (obtained by plant biotechnology methods such as genetic engineering) which may also be treated according to the invention are herbicide-tolerant plants, i.e. plants made tolerant to one or more given herbicides. Such plants can be obtained either by genetic transformation, or by selection of plants containing a mutation imparting such herbicide tolerance.

Herbicide-tolerant plants are for example glyphosate-tolerant plants, i.e. plants made tolerant to the herbicide glyphosate or salts thereof. For example, glyphosate-tolerant plants can be obtained by transforming the plant with a gene encoding the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS). Examples of such EPSPS genes are the AroA gene (mutant CT7) of the bacterium Salmonella typhimurium (Comai et al., Science (1983), 221, 370-371), the CP4 gene of the bacterium Agrobacterium sp. (Barry et al., Curr. Topics Plant Physiol. (1992), 7, 139-145), the genes encoding a petunia EPSPS (Shah et al., Science (1986), 233, 478-481), a tomato EPSPS (Gasser et al., J. Biol. Chem. (1988), 263, 4280-4289) or an Eleusine EPSPS (WO 2001/66704). It can also be a mutated EPSPS, as described, for example, in EP-A 0837944, WO 2000/066746, WO 2000/066747 or WO 2002/026995. Glyphosate-tolerant plants can also be obtained by expressing a gene that encodes a glyphosate oxidoreductase enzyme as described in US
5,776,760 and US 5,463,175. Glyphosate-tolerant plants can also be obtained by expressing a gene that encodes a glyphosate acetyl transferase enzyme as described, for example, in WO 2002/036782, WO 2003/092360, WO 2005/012515 and WO 2007/024782. Glyphosate-tolerant plants can also be obtained by selecting plants containing naturally occurring mutations of the above-mentioned genes as described, for example, in WO 2001/024615 or WO 2003/013226.

Other herbicide-resistant plants are for example plants have been made tolerant to herbicides inhibiting the enzyme glutamine synthase, such as bialaphos, phosphinotrichin or glufosinate. Such plants can be obtained by expressing an enzyme detoxifying the herbicide or a mutant glutamine synthase enzyme that is resistant to inhibition. One such efficient detoxifying enzyme is, for example, an enzyme encoding a phosphinotrichin acetyltransferase (such as the bar or pat protein from Streptomyces species). Plants expressing an exogenous phosphinotrichin acetyltransferase have been described, for example, in US 5,561,236; US 5,648,477; US 5,646,024; US 5,273,894; US 5,637,489; US 5,276,268; US 5,739,082; US 5,908,810 and US 7,112,665.

Further herbicide-tolerant plants are also plants that are made tolerant to the herbicides inhibiting the enzyme hydroxyphenylpyruvatedioxygenase (HPPD). Hydroxyphenylpyruvatedioxygenases are enzymes that catalyse the reaction in which para-hydroxyphenylpyruvate (HPP) is transformed into homogentisate. Plants tolerant to HPPD-inhibitors can be transformed with a gene encoding a naturally-occurring resistant HPPD enzyme, or a gene encoding a mutated HPPD enzyme according to WO 1996/038567, WO 1999/024585 and WO 1999/024586. Tolerance to HPPD-inhibitors can also be obtained by transforming plants with genes encoding certain enzymes enabling the formation of homogentisate despite the inhibition of the native HPPD enzyme by the HPPD-inhibitor. Such plants and genes are described in WO 1999/034008 and WO 2002/36787. Tolerance of plants to HPPD inhibitors can also be improved by transforming plants with a gene encoding an enzyme prephenate dehydrogenase in addition to a gene encoding an HPPD-tolerant enzyme, as described in WO 2004/024928.

Further herbicide-resistant plants are plants that have been made tolerant to acetolactate synthase (ALS) inhibitors. Known ALS inhibitors include, for example, suiphonylurea, imidazolinone, triazolopyrimidines, pyrimidinloxy(thio)benzoates, and/or sulphonylaminocarbonyltriazolinone herbicides. Different mutations in the ALS enzyme (also known as acetohydroxy acid synthase, AHAS) are known to confer tolerance to different herbicides and groups of herbicides, as described, for example, in Tranel and Wright, Weed Science (2002), 50, 700-712, and also in US 5,605,011, US 5,378,824, US 5,141,870 and US 5,013,659. The production of sulphonylurea-tolerant plants and imidazolinone-tolerant plants has been described in US 5,605,011; US 5,013,659; US 5,141,870; US 5,767,361; US 5,731,170; US 5,304,732; US 4,761,373; US 5,331,170; US 5,928,937; and US 5,378,824; and also in the international publication WO 1996/033270.

5 Other plants tolerant to imidazolinone and/or sulphonylurea can be obtained by induced mutagenesis, by selection in cell cultures in the presence of the herbicide or by mutation breeding, as described, for example, for soya beans in US 5,084,082, for rice in WO 1997/41218, for sugar beet in US 5,773,702 and WO 1999/057965, for lettuce in US 5,198,599 or for sunflower in WO 2001/065922.

Plants or plant varieties (obtained by plant biotechnology methods such as genetic engineering) which may also be treated according to the invention are insect-resistant transgenic plants, i.e. plants made resistant to attack by certain target insects. Such plants can be obtained by genetic transformation, or by selection of plants containing a mutation imparting such insect resistance.

In the present context, the term "insect-resistant transgenic plant" includes any plant containing at least one transgene comprising a coding sequence encoding:

1) an insecticidal crystal protein from _Bacillus thuringiensis_ or an insecticidal portion thereof, such as the insecticidal crystal proteins listed by Crickmore et al., Microbiology and Molecular Biology Reviews (1998), 62, 807-813, updated by Crickmore et al. (2005) in the _Bacillus thuringiensis_ toxin nomenclature, online at:

http://mvw.iifesci.sussex.ac.uk/Home/Neil___Crickmore/Bt/), or insecticidal portions thereof, for example proteins of the Cry protein classes Cry1Ab, Cry1Ac, Cry1F, Cry2Ab, Cry3Ae or Cry3Bb or insecticidal portions thereof; or

2) a crystal protein from _Bacillus thuringiensis_ or a portion thereof which is insecticidal in the presence of a second other crystal protein from _Bacillus thuringiensis_ or a portion thereof, such as the binary toxin made up of the Cy34 and Cy35 crystal proteins (Moellenbeck et al., Nat. Biotechnol. (2001), 19, 668-72; Schnepf et al., Applied Environm. Microb. (2006), 71, 1765-1774): or

3) a hybrid insecticidal protein comprising parts of two different insecticidal crystal proteins from _Bacillus thuringiensis_, such as a hybrid of the proteins of 1) above or a hybrid of the proteins of 2) above, for example the Cry1A.105 protein produced by maize event MON98034 (WO 2007/027777); or
4) a protein of any one of 1) to 3) above wherein some, particularly 1 to 10, amino acids have been
replaced by another amino acid to obtain a higher insecticidal activity to a target insect species,
and/or to expand the range of target insect species affected, and/or because of changes induced in
the encoding DNA during cloning or transformation, such as the Cry3Bbl protein in maize events
MON863 or MON88017, or the Cry3A protein in maize event MIR604; or

5) an insecticidal secreted protein from Bacillus thuringiensis or Bacillus cereus, or an insecticidal
portion thereof, such as the vegetative insecticidal proteins (VIP) listed at:
http://www.iifesci.sussex.ac.uk/home/Neii_Crickmore/Bt/vip.html, for example proteins from the
VIP3Aa protein class; or

6) a secreted protein from Bacillus thuringiensis or Bacillus cereus which is insecticidal in the
presence of a second secreted protein from Bacillus thuringiensis or B. cereus, such as the binary
toxin made up of the VIP! A and VIP2A proteins (WO 1994/21795); or

7) a hybrid insecticidal protein comprising parts from different secreted proteins from Bacillus
thuringiensis or Bacillus cereus, such as a hybrid of the proteins in 1) above or a hybrid of the
proteins in 2) above; or

8) a protein of any one of 1) to 3) above wherein some, particularly 1 to 10, amino acids have been
replaced by another amino acid to obtain a higher insecticidal activity to a target insect species,
and/or to expand the range of target insect species affected, and/or because of changes induced in
the encoding DNA during cloning or transformation (while still encoding an insecticidal protein),
such as the VIP3Aa protein in cotton event COT 102.

Of course, insect-resistant transgenic plants, as used herein, also include any plant comprising a combination
of genes encoding the proteins of any one of the above classes 1 to 8. In one embodiment, an insect-resistant
plant contains more than one transgene encoding a protein of any one of the above classes 1 to 8, to expand
the range of target insect species affected or to delay insect resistance development to the plants, by using
different proteins insecticidal to the same target insect species but having a different mode of action, such as
binding to different receptor binding sites in the insect.

Plants or plant varieties (obtained by plant biotechnology methods such as genetic engineering) which may
also be treated according to the invention are tolerant to abiotic stress factors. Such plants can be obtained
by genetic transformation, or by selection of plants containing a mutation imparting such stress resistance.
Particularly useful stress-tolerant plants include the following:
plants which contain a transgene capable of reducing the expression and/or the activity of the poly(ADP-ribose)polymerase (PARP) gene in the plant cells or plants, as described in WO 2000/004173 or EP 04077984.5 or EP 06009836.5.

b. plants which contain a stress tolerance-enhancing transgene capable of reducing the expression and/or the activity of the PARG encoding genes of the plants or plant cells, as described, for example, in WO 2004/090140;

c. plants which contain a stress tolerance-enhancing transgene coding for a plant-functional enzyme of the nicotinamide adenine dinucleotide salvage biosynthesis pathway, including nicotinamidase, nicotinate phosphoribosyltransferase, nicotinic acid mononucleotide adenyln transferase, nicotinamide adenine dinucleotide synthetase or nicotinamide phosphoribosyltransferase, as described, for example, in EP 04077624.7 or WO 2006/133827 or PCT/EP07/002433.

Plants or plant varieties (obtained by plant biotechnology methods such as genetic engineering) which may also be treated according to the invention show altered quantity, quality and/or storage-stability of the harvested product and/or altered properties of specific ingredients of the harvested product such as, for example:


Plants or plant varieties (obtained by plant biotechnology methods such as genetic engineering) which may also be treated according to the invention are are plants, such as cotton plants, with altered fibre characteristics. Such plants can be obtained by genetic transformation, or by selection of plants containing a mutation imparting such altered fibre characteristics and include:

a) plants, such as cotton plants, which contain an altered form of cellulose synthase genes, as described in WO 1998/000549,

b) plants, such as cotton plants, which contain an altered form of rsw2 or rsw3 homologous nucleic acids, as described in WO 2004/053219;

c) plants, such as cotton plants, with an increased expression of sucrose phosphate synthase, as described in WO 2001/017333;

d) plants, such as cotton plants, with an increased expression of sucrose synthase, as described in WO 2002/45485;

e) plants, such as cotton plants, wherein the timing of the plasmodesmatal gating at the basis of the fibre cell is altered, for example through downregulation of fibre-selective P-1,3-giuca.nase, as described in WO 2005/017157;
f) plants, such as cotton plants, which have fibres with altered reactivity, for example through the expression of the N-acetylglucosaminetransferase gene including nodC and chitin synthase genes, as described in WO 2006/136351.

Plants or plant cultivars (that can be obtained by plant biotechnology methods such as genetic engineering) which may also be treated according to the invention are plants, such as oilseed rape or related Brassica plants, with altered oil profile characteristics. Such plants can be obtained by genetic transformation or by selection of plants containing a mutation imparting such altered oil characteristics and include:

a) plants, such as oilseed rape plants, which produce oil having a high oleic acid content, as described, for example, in US 5,969,169, US 5,840,946 oder US 6,323,392 or US 6,063, 947;

b) plants, such as oilseed rape plants, which produce oil having a low linolenic acid content, as described in US 6,270828, US 6,169,190 or US 5,965,755.

c) plants, such as oilseed rape plants, which produce oil having a low level of saturated fatty acids, as described, for example, in US 5,434,283.

Particularly useful transgenic plants which may be treated according to the invention are plants which comprise one or more genes which encode one or more toxins are the transgenic plants available under the following trade names: YIELD GARD® (for example maize, cotton, soya beans), KnockOut® (for example maize), BiteGard® (for example maize), BT-Xtra® (for example maize), StarLink® (for example maize), Bollgard® (cotton), Nucotn® (cotton), Nucotn 33B® (cotton), NatureGard® (for example maize), Protecta® and NewLeaf® (potato). Examples of herbicide-tolerant plants which may be mentioned are maize varieties, cotton varieties and soya bean varieties which are available under the following trade names: Roundup Ready® (tolerance to glyphosate, for example maize, cotton, soya beans), Liberty Link® (tolerance to phosphinothricin, for example oilseed rape), JM® (tolerance to imidazolinone) and SCS® (tolerance to sulphonylurea, for example maize). Herbicide-resistant plants (plants bred in a conventional manner for herbicide tolerance) which may be mentioned include the varieties sold under the name Clearfield® (for example maize).

Particularly useful transgenic plants which may be treated according to the invention are plants containing transformation events, or a combination of transformation events, that are listed for example in the databases of various national or regional regulatory agencies (see for example http://gmoinfo.jrc.it/gmp_browse.aspx and http://www.agbios.com/dbase.php).
Fig. 1(a) to 1(c) and Fig. 2(a) to 2(c) show the effect of fungicide treatments on the leaf surface temperature of stressed wheat plants. Fungicides were applied at BBCH 37-39. The effect was measured by Infrared-Thermography either 3 weeks (Fig. 1(a) to 1(c)) or 5 weeks (Fig. 2(a) to 2(c)) after fungicide application. In the original, colored pictures, colored bars at the right side of each figure indicate the corresponding leaf temperature from 22.5°C on the top (dark red) to 20°C in the middle (white) to 17.5°C at the bottom (dark blue). The more and darker blue the color of the plant tissue (indicated by marked arrows in the black and white figures), the lower is the surface temperature, the larger are the stomatal openings, and the less stressed and the less senescent is the plant. The more white or light blue the color of the plant tissue, the higher is the surface temperature, and the more stressed is the plant. The corresponding color pictures of the Infrared-Thermographies may be provided on request.

Fig. 1 shows Infrared-Thermographies of stressed wheat plants at 3 weeks (about BBCH 59) after fungicide treatment.

Fig. 1(a) shows untreated (no fungicide treatment but stressed) control [1] vs. bixafen treatment [2]. Fig 1(b) shows untreated control vs. treatment with a combination of bixafen and tebuconazole [3]. Fig 1(c) shows untreated control vs. treatment with a combination of pyraclostrobin and epoxiconazole [4]. Fungicide-treated wheat plants cultivated under restricted water supply demonstrated a lower leaf temperature corresponding to a higher transpiration rate than untreated wheat, revealing a higher stomatal conductance favoring the photosynthesis. Wheat plants treated with bixafen or a combination of bixafen and tebuconazole displayed a lower leaf temperature corresponding to a higher transpiration rate than wheat plants treated with pyraclostrobin and epoxiconazole indicating a better drought stress tolerance.

Without being bound, the major part of the control plants as shown in figure 1(a) to 1(c) displays in the thermoscan a color referring to around 19.3 to 19.8 °C. Also without being bound, the major part of the treated plants as shown in figure 1(a) displays in the thermoscan a color referring to around 17.5 to 18.0°C, in picture 1(b) around 17.3 to 17.8 °C, and in picture 1(c) around 19.0 to 19.5 °C.

Fig. 2 shows Infrared-Thermographies of stressed wheat plants at 5 weeks (BBCH 75) after fungicide treatment.

Fig. 2(a) shows untreated control [1] vs. bixafen treatment [2]. Fig 2(b) shows untreated control vs. treatment with a combination of bixafen and tebuconazole [3]. Fig 2(c) shows untreated control vs. treatment with a combination of pyraclostrobin and epoxiconazole [4]. Fungicide-treated wheat plants cultivated under restricted water supply demonstrated a lower leaf temperature corresponding to a higher transpiration rate than untreated wheat, revealing a higher stomatal conductance favoring the photosynthesis and a delay in senescence.
Without being bound, the major part of the control plants as shown in picture 2(a) to 2(c) displays in the thermoscan a color referring to around 19.3 to 19.8 °C. Also without being bound, the major part of the treated plants as shown in figures 2(a), 2(b), and 2(c) displays in the thermoscan a color referring to around 19.0 to 19.5 °C.

The examples which follow illustrate the invention, but do not limit it.
Biological Examples

Spring wheat (cv. "Passat") was cultivated in Einheitserde P / Landerde (ratio 1:1) with 4 plants / pot (pot size = 4 L) in the greenhouse. The plants were cultivated under disease free conditions, and 12 h light. Before fungicide application, the plants were cultivated at 10 °C / 80 % rel. humidity, after fungicide application, the plants were cultivated at 18 °C / 50 % rel. humidity. The fungicide(s) were applied by spray application in a spraying cabinet in a water volume of 500 L/ha, at BBCH 39. Four replicates were done per treatment (4 pots per treatment).

In order to simulate a marginal drought stress, treatments 2 to 5 were performed under reduced water supply, starting at BBCH 39. In addition, starting at 10 days after fungicide application, a 3-days heat stress was induced (28 °C day / 24 °C night: 50-60 rel. humidity).

Treatment list:

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Formulation</th>
<th>l/ha</th>
<th>g a.i./ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 UTC (non-stressed)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2 UTC (stressed)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>3 Bixafen (stressed)</td>
<td>125EC</td>
<td>0,4</td>
<td>50</td>
</tr>
<tr>
<td>4 Zantara (stressed)</td>
<td>216EC</td>
<td>1</td>
<td>50 + 166</td>
</tr>
<tr>
<td>5 Pyraclostrobin + Epoxiconazole (stressed)</td>
<td>125SE</td>
<td>1,5</td>
<td>187,5</td>
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</table>

Assessment parameters:

Continuous measurement of chlorophyll a fluorescence was performed to determine the Maximum quantum efficiency of PSII (Fv/Fm) of flag leaf and F1 starting at growth stage BBCH 49 by using a HandyPEA (Hansatech Instruments Ltd, Norfolk, England).

Sequential evaluation of the leaf surface temperature was performed by IR-thermography using a VarioCAM® hr research (InfraTec GmbH, Dresden, Germany). Results are shown in Fig. 1 (a) to (c) and Fig. 2 (a) to (c).

The following yield parameters were determined at harvest:

- Number of ears/pot
- Number of kernels/ear
- Kernel weight/ear
- Thousand kernel weight
- Yield/pot

RESULTS

*Tab.1: Maximum quantum efficiency of PSII (Fv/Fm) of flag leaf*

<table>
<thead>
<tr>
<th>Growth stage [BBCH]</th>
<th>Untreated (non-stressed)</th>
<th>Untreated (stressed)</th>
<th>Bixafen (stressed)</th>
<th>Bixafen + Tebuconazole (stressed)</th>
<th>Pyraclostrobin + Epoxiconazole (stressed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>0.837</td>
<td>0.842</td>
<td>0.836</td>
<td>0.84</td>
<td>0.838</td>
</tr>
<tr>
<td>59</td>
<td>0.825</td>
<td>0.83</td>
<td>0.829</td>
<td>0.828</td>
<td>0.83</td>
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<tr>
<td>69</td>
<td>0.813</td>
<td>0.818</td>
<td>0.813</td>
<td>0.816</td>
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<tr>
<td>75</td>
<td>0.796</td>
<td>0.801</td>
<td>0.792</td>
<td>0.796</td>
<td>0.8</td>
</tr>
<tr>
<td>85 - 87</td>
<td>0.784</td>
<td>0.635</td>
<td>0.766</td>
<td>0.772</td>
<td>0.727</td>
</tr>
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</table>

*Tab.2: Maximum quantum efficiency of PSII (Fv/Fm) of leaf F-1*

<table>
<thead>
<tr>
<th>Growth stage [BBCH]</th>
<th>Untreated (non-stressed)</th>
<th>Untreated (stressed)</th>
<th>Bixafen (stressed)</th>
<th>Bixafen + Tebuconazole (stressed)</th>
<th>Pyraclostrobin + Epoxiconazole (stressed)</th>
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<tbody>
<tr>
<td>49</td>
<td>0.805</td>
<td>0.828</td>
<td>0.831</td>
<td>0.83</td>
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<tr>
<td>59</td>
<td>0.805</td>
<td>0.807</td>
<td>0.81</td>
<td>0.816</td>
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<tr>
<td>69</td>
<td>0.799</td>
<td>0.806</td>
<td>0.802</td>
<td>0.806</td>
<td>0.799</td>
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<tr>
<td>75</td>
<td>0.781</td>
<td>0.699</td>
<td>0.776</td>
<td>0.783</td>
<td>0.729</td>
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<tr>
<td>85 - 87</td>
<td>0.779</td>
<td>0.273</td>
<td>0.422</td>
<td>0.516</td>
<td>0.333</td>
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</table>

*Tab.3: Number of ears/plot per pot*

<table>
<thead>
<tr>
<th>Replicate (pot)</th>
<th>Untreated (non-stressed)</th>
<th>Untreated (stressed)</th>
<th>Bixafen (stressed)</th>
<th>Bixafen + Tebuconazole (stressed)</th>
<th>Pyraclostrobin + Epoxiconazole (stressed)</th>
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<tbody>
<tr>
<td>1</td>
<td>21</td>
<td>13</td>
<td>16</td>
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<td>2</td>
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<td>3</td>
<td>23</td>
<td>15</td>
<td>16</td>
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<td>12</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
<td>14</td>
<td>14</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Mean</td>
<td>23</td>
<td>14</td>
<td>15.3</td>
<td>14.8</td>
<td>12.3</td>
</tr>
</tbody>
</table>
**Tab.4: Grain yield fg\per pot**

<table>
<thead>
<tr>
<th>Replicate (pot)</th>
<th>Untreated (non-stressed)</th>
<th>Untreated (stressed)</th>
<th>Bixafen (stressed)</th>
<th>Bixafen + Tebuconazole (stressed)</th>
<th>Pyraclostrobin + Epoxiconazole (stressed)</th>
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<tbody>
<tr>
<td>1</td>
<td>52.93</td>
<td>38.6</td>
<td>39.29</td>
<td>42.55</td>
<td>37.82</td>
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<td>2</td>
<td>56.73</td>
<td>34.73</td>
<td>39.89</td>
<td>44.25</td>
<td>38.34</td>
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<td>3</td>
<td>50.89</td>
<td>35.1</td>
<td>42.16</td>
<td>41.62</td>
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</tr>
<tr>
<td>4</td>
<td>51.44</td>
<td>38.51</td>
<td>42.19</td>
<td>40.1</td>
<td>36.44</td>
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<tr>
<td>Mean</td>
<td>53</td>
<td>36.74</td>
<td>40.88</td>
<td>42.13</td>
<td>37.76</td>
</tr>
</tbody>
</table>

**Tab.5: Number of kernels per ear**

<table>
<thead>
<tr>
<th>Replicate (ear)</th>
<th>Untreated (non-stressed)</th>
<th>Untreated (stressed)</th>
<th>Bixafen (stressed)</th>
<th>Bixafen + Tebuconazole (stressed)</th>
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<tbody>
<tr>
<td>1</td>
<td>84</td>
<td>82</td>
<td>73</td>
<td>80</td>
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<tr>
<td>2</td>
<td>75</td>
<td>58</td>
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<td>69</td>
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**Tab. 5: Kernel weight [g] per ear**

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Tab. 5: Thousand kernel weight (g)

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Claims

1. Use of fungicidal combinations comprising (a) bixafen and (b) tebuconazole for increasing the tolerance of a plant species from the family of the true grasses (*Poaceae*) towards at least one abiotic stress factor.

2. Use according to Claim 1, characterized in that the increased tolerance of the plant towards the at least one stress factor is exemplified by an increased yield.

3. Use according to Claim 1 or 2, characterized in that the number of ears per area and the grain yield per area is increased.

4. Use according to any of Claims 1 to 3, characterized in that the increased tolerance of the plant towards the at least one stress factor is exemplified by an improved physiological condition of the plant.

5. Use according to Claim 4, characterized in that the improved physiological condition of the plant is exemplified by at least one feature selected from a stabilization of the photosynthetic efficiency of the plant, a higher transpiration rate, a lower leaf surface temperature, and a delay in senescence.

6. Use according to Claim 4 or 5, characterized in that the stabilization of the photosynthetic efficiency occurs at growth stage BBCH 77 and later.

7. Use according to any of Claims 4 to 6, characterized in that the lower leaf surface temperature occurs at growth stages BBCH 55 to 65.

8. Use according to any of Claims 1 to 7, characterized in that the at least one abiotic stress factor is selected from the group consisting of drought, cold temperature exposure, heat exposure, osmotic stress, waterlogging, increased soil salinity, increased concentration of minerals, exposure to ozone, exposure to strong light, limited availability of nitrogen nutrients, and limited availability of phosphorus nutrients.

9. Use according to any of Claims 1 to 8, characterized in that the at least one abiotic stress factor is selected from drought and heat exposure.

10. Use according to any of Claims 1 to 9, characterized in that the fungicidal combination is applied to the plant before the appearance of the at least one abiotic stress factor.
11. Use according to any of Claims 1 to 10, characterized in that the fungicidal combination is applied to the plant in the development stages BBCH 33 to 55, preferably in the development stages BBCH 33 to 49.

12. Use according to any of Claims 1 to 11, characterized in that the fungicidal combination is applied in combination with at least one further agrochemically active compound selected from the group of fungicides, insecticides, acaricides, nematicides, herbicides, safeners, bactericides, biologicals, hormones, pheromones, and active compounds with unknown or unspecific mechanisms of action.

13. Use according to Claim 12, characterized in that the at least one further fungicidally active compound is selected from prothioconazole and fluopyram.

14. Use according to any of Claims 1 to 13, characterized in that the plant species from the family of the true grasses (Poaceae) is selected from the group consisting of wheat, rye, barley, oats, millet, maize, rice, triticale, bamboo, and sugarcane.

15. Use according to any of Claims 1 to 14, characterized in that the treated plant is transgenic.

16. Use according to any of Claims 1 to 15, characterized in that the fungicidal combination is applied at an application rate of from 0.01 to 3 kg a.i./ha.

17. Use according to any of Claims 1 to 16, characterized in that the ratio of (a) bixafen to (b) tebuconazole is from 20:1 to 1:20.

18. Use according to Claim 17, characterized in that the ratio of (a) bixafen to (b) tebuconazole is from 1:1 to 1:5.

19. Method for treating a plant or parts of plants of species from the family of the true grasses (Poaceae) for increasing the tolerance to abiotic stress factors, characterized in that the plants or parts of plants are treated with a fungicidal combination comprising (a) bixafen and (b) tebuconazole.

20. Method for increasing the tolerance of seed and germinating plants to abiotic stress factors by treating the seed with a fungicidal combination comprising (a) bixafen and (b) tebuconazole.
Fig. 1(a)

1. White and light blue color
2. Blue and dark blue color

[1] Untreated control, stressed
[2] Treatment with bixafen, stressed

Fig. 1(b)

1. White and light blue color
2. Dark blue color

[1] Untreated control, stressed
[3] Treatment with bixafen and tebuconazole, stressed
Fig. 1(c)

[1] Untreated control, stressed
[4] Treatment with pyraclostrobin and epoxiconazole, stressed

Fig. 2(a)

[1] Untreated control, stressed
[2] Treatment with bixafen, stressed
Fig. 2(b)

[1] Untreated control, stressed
[3] Treatment with bixafen and tebuconazole, stressed

Fig. 2(c)

[1] Untreated control, stressed
[4] Treatment with pyraclostrobin and epoxiconazole, stressed
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01N43/56 A01N43/653 A01P15/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A01N A01P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of Box C.  [X] See patent family annex.

* Special categories of cited documents:

A Document defining the general state of the art which is not considered to be of particular relevance

E Earlier application or patent but published on or after the international filing date

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T Later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X Document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y Document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken in combination with one or more other such documents, such combination being obvious to a person skilled in the art

A Document member of the same patent family

Date of the actual completion of the international search: 7 October 2013

Date of mailing of the international search report: 14/10/2013

Name and mailing address of the ISA:
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, (+31-70) 340-3016

Authorized officer: Staber, Bri gitte
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