Abstract: The present invention relates to a method for identifying the origin of cotton fiber by determining a set of chemical properties of said cotton fiber wherein the set of chemical properties are ash content, moisture content, wax content and heavy metals content; determining a set of physical properties of said cotton fiber wherein the set of physical properties in the present invention are fiber length, fiber bundle strength, fiber maturity, fiber elongation, trash content, tensile strength, fiber uniformity and micronaire value; and correlating the obtained physical properties and chemical properties with the method of cultivation to identify the origin of said cotton fiber. The method of cultivation in the present invention is organic agricultural method or conventional agricultural method and the cotton fiber is organic cotton fiber having no pesticide content or convention cotton fiber preferably of the same variety. The present invention also discloses the use of the method of the present invention for the identification, segregation, authentification and/or certification of the organically grown cotton fiber from conventionally grown cotton fiber.
METHOD FOR DETERMINATION OF COTTON FIBER CULTIVATION METHOD

FIELD OF INVENTION

The present invention provides a method for identifying and differentiating organic cotton from conventional cotton. The present invention relates to a method for analyzing the impact of pesticides on organic cotton fiber and conventional cotton. The present invention also relates to the determination of physico-chemical properties of organic cotton and conventional cotton. The present invention further relates to the differentiation and analysis of textile properties of organic cotton and conventional cotton fibers.

BACKGROUND AND PRIOR ART OF THE INVENTION

Worldwide cotton is considered the most consumable textile fiber in the textile industry. Nearly 200 million growers and similar number of laborers are employed in producing in 80 countries. Cotton is also the most important fiber crop of India. It is the back bone of Indian textile industry, accounting 70 % of total fiber consumption and 38% of the country's export fetching over 42,000 crores Ramamurthy, et al. (1996) (Organic Cotton: Status Review in India. Clothesline. September. Pp 91-96).

The world's most consumable fiber, cotton, is in focus in the field of various researchers and agronomists for the improvement in its unsafe cultivation practices. Strenuous efforts are being made to increase its production by intensive use of synthetic chemical fertilizers and pesticides, posing serious problems to health and environment. Cotton processing, right from the cultivation in the fields to the stage of manufacturing and finishing of a cotton product requires tons of harmful chemicals, due to which pollution is caused. Among the cataloguing of problems associated with conventional cotton production, excessive use of pesticides is perhaps the most serious problem and is the main motivation for many people and organizations to seek changes in current production systems. A large quantity of acute toxic pesticides as cotton is very prone to insect infections and because of its very nature it cannot be sustained without high levels of fertilizers and pesticides. Various studies have revealed the harmful effects of conventionally grown cotton on human skin because of the extreme use of pesticides and fertilizers in its production and cultivation. Synthetic pesticides and fertilizers have not only taken away the farmer's profit but also affected fertility of earth. It is a well known fact that about 60% of the cotton crop, by weight, enters the human food chain
through cotton seed oil. Spraying of pesticides on cotton also contaminates groundwater due to leeching out. Besides this, use of heavy doses of nitrogen fertilizers speeds up the mineralization process in the soil, which leads to break down of organic matter in the topsoil.

Another problem associated with conventional intensive agricultural methods for cultivation of cotton is that it is an ecologically destructive crop. Conventional cotton requires the use of large quantities of chemical pesticides. In response to disease and insect pests, the majority of cotton producers become dependent on a chemical arsenal which impacts heavily upon the soil and surrounding environment. The scale of this problem can be understood from estimations that cotton production accounts for one quarter of the total volume of pesticides used throughout the world each year. After a while, continued application of these pesticides contributes to sterile soils. Because they become devoid of the living organisms which promote normal nutrient recovery and plant growth, sterile soils are dependent upon a continual application of synthetic fertilisers.

To reach maturity, cotton crop requires substantial irrigation. This interacts with water soluble chemicals to create ongoing problems of groundwater pollution, salination and erosion. The problems of intensive or conventional cotton production may impact on our health and wellbeing in a variety of ways. Pesticides enter the human food chain directly through soil and groundwater contamination, or as a residue within processed foods containing cottonseed oil. Cattle and other stock are routinely fed cottonseed meal and other material salvaged from cotton harvesting. Products sourced from these animals may be contaminated with pesticide residue from the cotton. Despite assurances of minimal risk, many consumers remain concerned that a significant proportion of cotton is now raised from genetically modified seed. The principal reason for their genetic modification is to facilitate resistance to the herbicides employed to eradicate weeds after sowing.

The best alternative to mainstream cotton production is based on organic principles. Organic farming eliminates the use of harmful chemicals, genetically modified organisms, and protects the environment by promoting healthy soils, clean water, and natural biodiversity. Organic production utilises a range of strategies which are fundamentally different from those associated with conventional cotton farming. In broad terms, organic production is fully integrated within a system which is based on
the positive combination of ecological and economic relationships. Organic cotton is grown in a sustainable manner that supports the broader ecosystem.

Organically grown cotton is proved to be a successful alternative of the conventional cotton available worldwide. Environmental organizations and consumers are looking for sustainable alternative due to chemical intensive cultivation practices of conventional cotton. It has several associated human health, social and economic hazards. Researches have revealed the social, economical and environmental impact of pesticides and synthetic fertilizers on cotton cultivators. So, worldwide organic cotton is certified by the means of standards and certification measures formed by various NGO's and Government organizations like IFOAM and USDA.

Certification of organic cotton production and processing adds credibility to the final products. Certification provides a comprehensive system for ensuring that certain standards of organic production and processing are met. The system includes:

1. Setting of Standards - Developing rules or standards
2. Inspection - Verifying and evaluating performance against those standards
3. Certification - Recognizing producers who successfully meet the standards

Certification standards and programs vary, especially in response to regional differences, although there are general underlying concepts. Certification of organic agriculture focuses on the production system rather than the products and organic cotton fiber properties and production should therefore be viewed as part of the wider system as reported in Myers & Stolton, 1999 (Myers, D. Stolton, S. (1999) Organic cotton: From Field to the Final Product. Pesticide Action Network, (PAN) UK. Intermediate Technology Publications, London).

Therefore, to meet the challenges of clean processing and current ecological requirements, an eco-friendly production route is the need of the hour. This major issue is being tackled by fostering the cultivation of Organic cotton' which is grown with the help of green manures and organic fertilizers thus avoiding synthetic inorganic fertilizers, pesticides fungicides, herbicides, growth regulators and defoliants. Organic cotton is an eco-friendly fiber, cultivation of which is not harmful to the environment and public health. As a result, the organic methods of cotton cultivation were promoted worldwide to reduce the application of harmful pesticides and synthetic fertilizers during cotton cultivation. The cotton grown using organic principles of agriculture is promoted worldwide by the name of organic cotton.
In the early 1990s, an emerging ecofashion trend fueled the demand for environmental textile and apparel products and exposed companies and consumers to the positive attributes of organically grown cotton. Between 1993 and 1994, the ecofashion trend reached its peak. In 1995, nearly 25,000 acres of organic cotton were planted, largely on speculation. This was a big jump compared to less than 1,000 acres planted in 1990. Things looked very positive, but then apparel companies driving the demand and experimenting with organic cotton programs withdrew from the market. These firms reported supply problems, higher production costs, consumer price resistance and marketing barriers in the textile and apparel industry as considerable challenges for continued growth. As a result, organic cotton acreage dropped considerably as organic growers switched to crops with more stable markets.

While the initial up and down cycle in the organic cotton industry has challenged organic cotton farmers and apparel companies alike, it must be seen as an inevitable transition and learning experience in a new and emerging industry. Lately organic cotton has seen a renewed demand in the international market. The positive environmental attributes of organic cotton that originally inspired the ecofashion trend are at the core of a renewed demand. Many companies are developing programs that blend small percentages of organic cotton into their conventional cotton products. Such developments are a hopeful sign for organic cotton use in the larger apparel industry.

Blending programs have the potential to use increasingly significant amounts of organic cotton. Blending offers some companies more flexibility and cost savings throughout the cotton production chain while supporting organic cotton farmers and increasing organic cotton acreage. As demand increases from both 100 percent organic cotton companies and blenders, forward contracts and preplant commitments are stabilizing the market and stimulating an expansion of organic cotton acreage. Organic products are gaining strength in the market. With the rising awareness, a considerable change in the consumer preference is being noticed. It’s an industry movement owing to high consumer demand; apparel industry is witnessing a general shift in material used. The standards are elevating and inclination is more towards the use of organic fiber in the mainstream products rather than the conventional. Consumers now-a-days care equally for the quality as well as environment. Organic cotton fibers provide the opportunity for market differentiation, particularly among companies with a high quality brand image.
But this trend towards the organic cotton preference can only be sustained if the authenticity of organic cotton can be maintained. However, as there is no labeling system to differentiate, identify and label organic cotton or blended organic cotton products, it is not possible to develop reliability of organic cotton in the industry, especially in textile industry.

The principles of organic agriculture were established by respective national and international cotton research organizations worldwide and farmers and manufactures were educated by there efforts to use the organic principles and methods of organic agriculture to cultivate organic cotton. IFOAM Manual has provided the essential principles involved in the conversion of farms into organic from conventional cultivation. The Agricultural Products Exports Development Authority (APEDA) of the Ministry of Commerce, Government of India also has formulated standards similar to IFOAM (CICR, 2000: CICR Technical Bulletin No. 1/200; CICR Publications. Central Institute of Cotton Research, Nagpur, Maharashtra).

A certification procedure was established to ensure that cotton which is claimed as "organic cotton" is grown by organic principles of agriculture.

Lots of research is being carried out worldwide for the development of best organic cotton cultivation practices. Cotton researchers of different organizations have researched to develop the suitable varieties for organic cotton. Breeding for superior varieties has received the full attention of researchers in most countries (ICAC, 1994: International Cotton Advisory Committee Report, (1994). ICAC Report. October. PpN-IS).

Different countries in the world are studying different composting, manuring and green fertilization techniques to achieve the best results in organic farming suitable to individual country climatic conditions and fertilizers available. CICR India has also conducted four year study on the cultivation procedures and varietals selection for organic cotton till 1999. Indian agricultural universities have also carried out research in the field of organic cotton cultivation practices and varietals selection suited to Indian climatic conditions.

Research has been carried out to evaluate the yield/cost analysis, productivity analysis, pest control techniques, tied crop rotation techniques, price premium analysis worldwide by individual governments (ICAC, 2003: International Cotton Advisory Committee Report, (2003); ICAC Recorder, www.icac.org). Now in various countries the research is focused on the formulations of standards for commercialization of
organic cotton and its certification for export purposes. The Indian government have started the initiatives and working on the formulations for Indian standards for organic cultivation. (Myers & Stolton, 2004).

Research is constantly underway world wide on organic cotton from the agricultural and certification point of view. Processes have been established to cultivate organic cotton by using organic methods of agriculture. Processes and standards have been established to adopt the organic methods of cultivation and standards have been established to certify the cotton farm as a certified organic farm and resultant cotton as certified organic cotton.

The relationship of the pesticides usage with the presence of heavy metals ions in the composition of cotton fiber has already been expressed in Parmar, M.S., et al. (2000) (To study the Structural Behavior of Naturally Coloured Cotton and its Interaction with Different Chemicals. Colourage. September. Ppl5-24) wherein, it is described that the higher value of metal ions is directly attributed to the type of soil, fertilizer, pesticides used during cultivation. This study further expressed that as the metal ions like cobalt, cadmium, nickel, iron, calcium, sodium and phosphorus are supportive components of the cotton fiber structure and in turn forms a major components of cotton ash content after burning (Chakraborty et. al, 1992).

The wax in the primary wall is a source of the hydrophobic nature of the un-scoured cotton (Etters, J.N. (1999); Cotton Preparation with Alkaline Pectinases: An Environmental Advance; Textile Chemist and Colorist and American Dyestuff Reporter. November. Vol. 1. No. 3. pp33-36). The higher value of wax present in conventional cotton may contribute to more hydrophobic tendency than organic cotton.

The slight change that can be seen in the physical properties might be due to differences in growing methods Meike, 2002 (Meike, S. (2002): What's the Difference? November, www.cottonplus.com) as one cotton is cultivated by organic route while other conventional route.

There are no physically visual differences in the appearance and textile properties of organic cotton and conventional cotton. Significantly, no research studies have been done which differentiates the properties of organic cotton and its behavioral aspects in comparison with conventional cotton from textiles point of view. Moreover, no studies were found which establishes technical processes to identify the differences' in the physicochemical textile properties of organically and conventionally grown cotton from the textile industry point of view. Further no research studies were found
towards identifying those components and related properties which may differentiate
same variety of cotton grown differently.

Another significant problem faced by several textile manufacturers is to ensure
that the cotton-fiber supplied to them, actually are organically grown and not-

Need for the Present Invention: There is a long felt need to develop a process
which can establish the differences in the textiles properties of organically grown and
conventionally grown cotton especially for the authentication of the cotton fibers and
validating their identity for trade and commercial purposes.

There is an existing need in this area of technology to differentiate organic
cotton fibres and conventional cotton fibres so as to maintain standards and authenticity
of organic cotton in textile industry.

A significant problem faced by several textile manufacturers is to ensure that
the cotton fiber supplied to them is actually organically grown and not mislabeled by
violating the rules or sourcing the certifications in non-regulatory manner.

In order to control this problem, a testing method is required which can actually
differentiate between cotton fiber samples as label them as "organic".

By using the test method of the present invention it is possible to test/check
whether a cotton fiber sample is organic or not. The results of the present invention can
be claimed as Certified Organic by the laboratory which is standardizing and using this
method as a standard test method.

OBJECTS OF THE INVENTION

It is an important object of the present invention to develop a method for
identifying and/or differentiating the properties of organically grown cotton and
conventionally grown cotton fibers, preferably of the same variety.

Another object of the invention is to conduct a comparative analysis of the
properties of organically grown cotton and conventionally grown cotton, preferably of
the same variety.

Yet another object of the present invention is to establish a method to
differentiate the properties of organically grown cotton and conventionally grown
cotton fibers by identifying the differences in the physico-chemical properties of
organic cotton and conventional cotton, preferably of the same variety.

Still another object of the present invention is to establish the method of the
invention as a powerful tool in the cotton textile industry for the segregation,
authentification and identification of the organically grown cotton fiber for international trade, export and fiber identification purposes.

An additional object of the present invention is to establish the method of the invention as an additional and mandatory step for the authentification and certification of the organic cotton worldwide and thereby support the traders, textile manufactures and consumers for the identification of the authentic organic cotton products and help them to compare and identify its beneficial properties.

SUMMARY OF THE INVENTION

The present invention discloses a method for identifying the origin of cotton fiber by (a) determining a set of chemical properties of said cotton fiber wherein the set of chemical properties are selected from the group comprising ash content, moisture content, wax content, heavy metals content or combination thereof; (b) determining a set of physical properties of said cotton fiber wherein the set of physical properties are selected from the group comprising fiber length, fiber bundle strength, fiber maturity, fiber elongation, trash content, tensile strength, fiber uniformity, micronaire value or combinations thereof; (c) correlating the obtained physical properties and chemical properties with the method of cultivation to identify the origin of said cotton fiber.

In one embodiment of the present invention the method of cultivation is organic agricultural method or conventional agricultural method and the cotton fiber is organic cotton fiber or convention cotton fiber preferably of the same variety.

In yet another embodiment of the present invention the organic cotton fiber has no pesticide content.

In still another embodiment of the present invention the set of chemical properties comprises (a) determining the ash content of said cotton fiber; (b) determining the moisture content of said cotton fiber; (c) determining the wax content of said cotton fiber; and (d) determining the heavy metal content of said cotton fiber.

In another embodiment of the present invention the organic cotton fiber has low ash content, low wax content, low heavy metal content and high moisture content than the convention cotton fiber of the same variety.

In yet another embodiment of the present invention the ash content, wax content, and moisture content in said cotton fiber is determined as per the recommended IS: 199 Standard test and the heavy metal content is determined by Atomic Absorption Spectrophotometer.
In still another embodiment of the present invention the heavy metals are selected from the group comprising Cobalt, Iron, Nickel, Copper, Cadmium, Lead, Calcium and Chromium.

In another embodiment of the present invention the set of physical properties comprises (a) determining the fiber length; (b) determining the fiber bundle strength; (c) determining the fiber maturity; (d) determining the micronaire value.

In still another embodiment of the present invention the organic cotton fiber has high fiber length, high fiber bundle strength, high fiber maturity, high micronaire value than the convention cotton fiber of the same variety.

In yet another embodiment of the present invention the physical properties are analysed and determined as per the ASTM D: 5867 standard by using Spin Lab HVI 900 Equipment such as herein described.

In another embodiment the present invention discloses the method for identifying the origin of cotton fiber by: (a) determining the amount of pesticides in said cotton fiber; (b) determining the physical and chemical properties of said cotton fiber; (c) assessing said cotton fiber against said physical and chemical properties to identify the origin of said cotton fiber.

In still another embodiment the present invention discloses the use of the method of the present invention for the identification, segregation, authentification and/or certification of the organically grown cotton fiber from conventionally grown cotton fiber.

**DETAILED DESCRIPTION OF THE INVENTION**

The present invention provides a method for identifying and differentiating organic cotton from conventional cotton, preferably of the same variety. The present invention relates to a method for analyzing the impact of pesticides on organic cotton fiber and conventional cotton. The method comprises of the physical and chemical tests for determining and identifying the key components in the fiber content which differentiate organically grown cotton and conventionally grown cotton of the same variety. This method is useful for the identification and authentication of organic cotton fiber and textiles for trade purposes.

The important part of the present invention is the establishment of a correlation between the cultivation methods and their direct impact on the fiber composition and properties. The present invention provides sequential test methods which show the impact and correlation of the cultivation methods like use of pesticides to the presence
of heavy metals, heavy metals to ash content and ash content to the moisture and wax content. All physical fiber properties are correlated to the cultivation methods used during production in the present invention.

By using the test method of the present invention it is possible to test/check whether a cotton fiber sample is organic or not. The base of the present invention is the presence of residual pesticides, which are identified and compared against the limits defined by soil association for acceptable limits of residual pesticides and heavy meals in organic products and the residue limits defined by CFR (central Federal Regulations), USA for conventional cotton. The first two tests establish the base for the product -whether it may be organic or not. If the results show inclination towards its organic behavior - Further, correlated tests (ash content, moisture and wax content and fiber physical properties) are performed to justify its organic behavior at each stage. Using the correlation established between the pesticides and various composition and fiber properties of cotton - all the other properties are measured in the suggested sequence.

The method of the present invention is useful for comparatively measuring the levels of pesticides in cotton fiber composition and evaluating the impact of pesticides used during cultivation on the textile properties (soil carbon content, fiber length, tensile strength, elongation, fiber uniformity, maturity coefficient, wax content, ash content and heavy metals analysis) of both types of cotton fibers. Using the method described herein a relationship between the above mentioned textile properties and resultant textiles performance behavior in terms of strength, durability, absorbency, hygienic (non-allergenic and non-carcinogenic), softness and hand feel properties can also be established.

In the detailed description and tables which follow, a number of terms are used. In order to provide a clear and consistent understanding of the invention, the following definitions are provided:

- **Conventionally grown cotton**: Cotton which is cultivated using pesticides, synthetic chemicals and fertilizers and best available technology is termed as Conventional Cotton.

- **Organically grown cotton or organic cotton**: Cotton which is cultivated by utilizing organic principles of agriculture (organic manures and biofertilisers) and cultivated without the use of synthetic chemical fertilizers, pesticides, growth regulators or defoliants is termed as Organic Cotton. Organic cotton production is
a system of growing cotton without synthetic chemical fertilisers, herbicides, conventional synthetic insecticides, growth regulators, growth stimulators, boll openers or defoliants. It is a system that contributes to healthy soils and/or people. The organic system promotes enhanced biological activity, encourages sustainability and commands proactive management of production. The term relates to the growing process of cotton and not to the subsequent processing stages.

❖ Fiber length: Fiber length is defined as the upper half mean length of the fiber as measured by HVI system in hundredths' of an inch. Cotton fiber length varies genetically and has a fiber length array or length distribution. The lengths of linters and comber noils are less than 0.5 inches.

❖ Fiber strength: Fiber strength is defined as the force required breaking a bundle of fibers as measured in grams per Tex on HVI. Fiber strength is measured by HVI using 1/8 inch spacing between clamp jaws and reported in terms of grams per tex. A tex unit is equal to the weight in grams of 1000 meters of fiber. Therefore, the strength reported is the force in grams required to break a bundle of fibers one tex unit in size.

❖ Fiber elongation: Fiber elongation is defined as the measure of elasticity of a bundle of fibers as measured by HVI.

❖ High Volume Instruments (HVI): High Volume Instruments (HVI) is defined as a measurement system for the classification of the cotton fibers. Cotton classification, or classing, is essential to the cotton pricing systems, but additional testing is required for high level quality control in textile production. Therefore, an instrument was developed to measure most fiber properties. This instrument is referred to as the High Volume Instrument (HVI). Its classification system currently consists of instrument measurements for fiber length, strength, length uniformity, micronaire, trash and color.

❖ Micronaire: Micronaire is defined as a measure of the fineness of fiber. Micronaire is an airflow measurement that is performed on a 2.34 grams test specimen which is compressed to a specific volume in a porous chamber. Air is forced through the specimen and the resistance to the airflow is proportional to the linear density of the fibers (expressed in micrograms per inch). Within a cotton cultivar, micronaire is also a measure of maturity. Micronaire differences are governed by changes in perimeter or in cell wall thickness, or by changes in both.
Within a variety, cotton perimeter is fairly constant and maturity will cause a change in micronaire. Consequently, micronaire has a huge correlation with maturity within a variety of cotton. Maturity is the degree of development of cell wall thickness. Micronaire may not have a good correlation with maturity between varieties of cotton having different perimeter. Micronaire value ranges from about 2.0 to 6.0.

In order to compare and differentiate the composition and related properties it is important to do comparison of same variety of cotton cultivated by using two different methods of cultivation i.e. conventional and organic. Cultivation, testing and comparison of the same variety of cotton (PUSA 8-6) were done for three continuous years (2002-2004). A certification phase of three years is recommended by government organizations based upon IFOAM standards. CICR (Central Institute for Cotton Research, Nagpur), initiated and carried out research on the principles of organic cotton agriculture in India. Based upon IFOAM standards, CICR have formulated Indian standards for organic cotton cultivation, varieties and methods of cultivation suitable to Indian climates and desi varieties of cotton based upon the research facts on cotton varieties available with CICR, cotton variety of PUSA 8-6 variety was selected for the cultivation of both organic and conventional cottons which is considered suitable for both organic and conventional principles of agriculture. The organic and conventional crop was cultivated (2002-2004) for three years. During the cultivation the factors like climatic conditions, location, farm size, variety, irrigation patterns, sowing, manuring time and period of cultivation were kept constant; only variables were the type of manures and fertilizers based upon the principles of agriculture. Pesticides and fertilizers used for conventional cultivation of cotton were Lindane and Cypermethriien.

For organic cultivation of cotton, Neem Oil and Triputi (gobar and pond sand) were used.

Soil preparation for cultivation: The method of the invention is based on the agricultural study and findings of CICR (Rajendran, T. P, et. al. (2001): Organic Cotton Farming in India), discussing that the certification and conversion phases of conventional farm to organic farm should be three-four years, as the Soil carbon content should reach up to 0.5 % and soil should be completely eliminated from pesticides after three years of organic cultivation. The organic carbon content in the soil should reach up-to the level of 0.50 ppm in order to consider the crop as organic crop. Such levels can be achieved with a transitional phase of organic cultivation of two to three years, if the field is being
directly converted from conventional to organic. Considering these factors, fortified soil was tested for the percentage of organic carbon content and the results are listed in Table 1.

Table 1: ANALYSIS OF SOIL PROPERTIES

<table>
<thead>
<tr>
<th>Sample mark</th>
<th>Ph (soil react-ion)</th>
<th>Soil remarks</th>
<th>*E.C (ds/m)</th>
<th>*Organic carbon %</th>
<th>Potash %</th>
<th>Available phosphorus per Kg/p/ha</th>
<th>Available micronutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample 1</td>
<td>8.2</td>
<td>Normal</td>
<td>0.15</td>
<td>0.54L</td>
<td>151.2m</td>
<td>13.7L</td>
<td>2.13</td>
</tr>
<tr>
<td>Sample 2</td>
<td>8.3</td>
<td>Normal</td>
<td>0.14</td>
<td>0.54m</td>
<td>145.6m</td>
<td>9.5L</td>
<td>2.60</td>
</tr>
<tr>
<td>Sample 3</td>
<td>8.2</td>
<td>Normal</td>
<td>0.20</td>
<td>0.53m</td>
<td>168m</td>
<td>13.7L</td>
<td>2.57</td>
</tr>
<tr>
<td>Sample 4</td>
<td>8.5</td>
<td>Normal</td>
<td>0.16</td>
<td>0.42L</td>
<td>168m</td>
<td>4.2L</td>
<td>2.16</td>
</tr>
<tr>
<td>Sample 5</td>
<td>8.5</td>
<td>Normal</td>
<td>0.23</td>
<td>0.43L</td>
<td>168m</td>
<td>4.2L</td>
<td>2.54</td>
</tr>
</tbody>
</table>

*E.C=measure of total soluble salts. *Organic carbon = measure of available soil

The soil was tested for its various properties. The soil test results in the first year of cultivation (2002) showed an average of 0.493% organic carbon content in the soil (as shown in Table I above) what was desirable for the crop to be called "organic".

Pesticide test: The second step of the method is to test the presence of pesticides in the organic and conventional cotton crops for three years as per the regulatory standards. The crop can be called organic only if the crop is free of pesticides by the third year of organic cultivation.

The determination of presence of chemical pesticides in the conventional and organic cottons is an important step in differentiating organic cotton from conventional cotton fibers. In conventional cotton cultivation Lindane and Cypermethrines were used as main pesticides, given thrice in a year to the conventional cotton crop. Organic cotton was treated with Neem oil and Trupati (mixture of gobar and pond sand) during cultivation mainly for all the three years. The presence of some residual pesticides was also expected due to unavoidable soil, air and water contamination.

As PUSA 8-6 variety of cotton was cultivated by organic as well as in conventional way, pesticides test were performed on both types of cottons for the three test years (2002-2004).

The presence of pesticides was estimated using A Hewlett Packard 6890 gas Chromatograph MSD 5973. Both organic and conventional cotton samples were
diluted to standard concentration of 100 ppb i.e. 0.1 µg/ml diluted in 5 ml Hexane. Samples weighing 5 gm were taken and the % of pesticides present was calculated using the formula:

\[
Ppb = \frac{\text{Area of the samples} \times \text{concentration of the Standard} \times \text{Dilution factor}}{\text{Area of standard} \times \text{weight of the samples}}
\]

The results obtained were evaluated in terms of percentage differences in the concentration of pesticides present in both types of cotton as given below in Table II.

### Table II: Presence of Pesticides in both Organic and Conventional Cottons

<table>
<thead>
<tr>
<th>Year</th>
<th>Gamma- (Lindane) (ppb)</th>
<th>HCH (ppb)</th>
<th>4,4-DDT (ppb)</th>
<th>Cypermethrien (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Cotton</td>
<td>22.90</td>
<td>41.86</td>
<td>76.09</td>
<td></td>
</tr>
<tr>
<td>Crop I (2002)</td>
<td>16.09</td>
<td>53.55</td>
<td>55.51</td>
<td></td>
</tr>
<tr>
<td>Crop II (2003)</td>
<td>6.58</td>
<td>16.85</td>
<td>23.7</td>
<td></td>
</tr>
<tr>
<td>Crop III (2004)</td>
<td>5.01</td>
<td>NT*</td>
<td>NT*</td>
<td></td>
</tr>
</tbody>
</table>

*NT: Not traceable

Above results show the excessive presence of pesticides in conventional cotton crop of 2002. Main pesticides Cypermethrien were 76.09 ppb and Lindane was 22.90 ppb; a high concentration of DDT as residual pesticides was traced up to 41.86 %. Alternatively, the presence of Cypermethrien in organic cotton crop I was found 55.51 ppb and Lindane 16.09 ppb. The pesticide test showed that the presence of main pesticides in organically grown cotton reduced drastically in second year of cultivation followed by almost nil presence in third year of cultivation. Initially the pesticides traces were found in the soil as residual pesticides as the organic cotton farming land previously was used for conventional cotton farming and as organic standards stated soil purified in three years to show almost negligent presence of Cypermethrien and Lindane in organic cotton farm.

**Determination of the composition of the cotton fiber:** The next step in the method of the invention is to determine the composition of the cotton fibers' structure and identify those components which get affected by the application of pesticides during...
cultivation. Since the presence of Cypermethrien, Lindane and DDT is determined in the pesticide test above, the fiber composition of both types of cottons is analysed for any difference in their compositions. The cotton fiber composition has been reported in Chakraborty, et al. (1998). (Processing of Cotton Knitted Fabrics. NITRA Publications. Northern India Textiles Research Association, Ghaziabad, India) as shown in Tables III, IV and V below along with detailed ash and wax content composition.

**Table III:** Composition of Cotton Fiber

<table>
<thead>
<tr>
<th>Fiber Composition</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose</td>
<td>94%</td>
</tr>
<tr>
<td>Wax like substances</td>
<td>0.6%</td>
</tr>
<tr>
<td>Organic acids</td>
<td>0.8%</td>
</tr>
<tr>
<td>Pectin’s</td>
<td>0.9%</td>
</tr>
<tr>
<td>Nitrogenous substances</td>
<td>1.3%</td>
</tr>
<tr>
<td>Ash</td>
<td>1.2%</td>
</tr>
<tr>
<td>Non cellulosic</td>
<td>0.3%</td>
</tr>
<tr>
<td>Poly saccharine &amp; unidentified substances</td>
<td>0.9%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Source: Chakraborty et al, 1998*

**Table IV:** Composition of Cotton Ash after burning

<table>
<thead>
<tr>
<th>Ash Composition</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium carbonate</td>
<td>44.8%</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>9.9%</td>
</tr>
<tr>
<td>Potassium sulphate</td>
<td>9.3%</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>10.6%</td>
</tr>
<tr>
<td>Magnesium sulphate</td>
<td>4.8%</td>
</tr>
<tr>
<td>Ferric oxide</td>
<td>3.0%</td>
</tr>
<tr>
<td>Aluminum oxide</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

*Source: Chakraborty et al, 1998*

**Table V:** Average Composition of cotton wax and oils

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturated fatty acid</td>
<td>24%</td>
</tr>
<tr>
<td>Unsaturated fatty acid</td>
<td>1%</td>
</tr>
<tr>
<td>Alcohols</td>
<td>52%</td>
</tr>
<tr>
<td>Sterols</td>
<td>10%</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>7%</td>
</tr>
<tr>
<td>Inert matter</td>
<td>6%</td>
</tr>
</tbody>
</table>

*Source: Chakraborty et al, 1998*
The relationship of the pesticides usage with the presence of heavy metals ions in the composition of cotton fiber has been reported in (Parmar, 2000) wherein, it is described that the higher value of metal ions is directly attributed to the type of soil, fertilizer, pesticides used during cultivation. This study further expressed that as the metal ions like cobalt, cadmium, nickel, iron, calcium, sodium and phosphorus are supportive components of the cotton fiber structure and in turn forms a major components of cotton ash content after burning (Chakraborty et al, 1992).

The next step of the method of the invention is testing both organic cotton and conventional cotton for the presence of heavy metals, presence of ash, wax and moisture content in the fibers. The present invention establishes the link between the compositions of the cotton fibers affected through cultivation procedures used for cultivation.

The present invention is illustrated and supported by the following examples. These are merely representative examples and optimization details and are not intended to restrict the scope of the present invention in any way.

EXAMPLE -1

**DETERMINATION OF PHYSICAL PROPERTIES OF COTTON FIBERS:**

**Determining the Ash content:** The IS: 199 Standard is recommended to test the percentage of ash content in cotton fibers. Three test specimens of one gram each was conditioned at 105°C overnight. Conditioned samples were transferred to silica crucible and were kept in muffle furnace for 6-7 hours at 800°C. Residue in the form of ash was estimated as per formula:

\[
\text{Ash Content percentage} = \frac{a}{b} \times 100
\]

Where,

\[a = \text{mass in grams of the residue (ash)}\]
\[b = \text{oven dry mass (calculated) in grams of the test specimen} \]

The level of significance in the differences of the mean values of both types of cottons was evaluated statistically by using Student’s t-test.

The method of the invention discloses (Table VI) the nonexistence of nickel, Cadmium, and Chromium in both organic and conventional cottons and the presence of Cobalt, Iron, Calcium and Lead. Further it shows higher percentages of values of metal ions like Iron and Copper in both cottons. Iron was found 71.81% higher and Copper was found 46.51% higher in conventional cotton compared to organic cotton. Lead and
Cobalt content were also found 31.41% and 58.46% higher respectively in conventional cotton. The higher value of metal ions in conventional cotton can also be supported by the higher value of ash content (Table VI), which was 1.06% higher in conventional cotton than organic cotton. The resultant values clearly revealed the total absence of Nickel, Chromium and Cadmium from both the cottons. Iron, Copper, Cobalt and Lead were found in higher concentrations in conventional cottons than organic cotton because of the usage of hormonal sprays containing Iron and Copper (Lindane and Cypermethrion) were given to the conventional cotton crop thrice in a year. The results show that in all, the metal ions were 62% lower in organic cotton than conventional cotton. Lower presence of heavy metals in organic cotton is the reason for lower ash content in organic cotton also. Because of lesser concentration of heavy metals and pesticides present in the fiber, organic cotton is considered hygienic, non allergenic and irritant free in nature.

**Determining the moisture content**: Moisture content was determined as per IS: 199 Standard. Three test specimens each weighing 3 grams of both types of cottons were weighed in weighing bottles and oven dried at 105°C to constant mass. The oven dry mass of the dried samples were determined using following formula:

\[
\text{Moisture content, } \% = \frac{(a-b/a) \times 100}{a}
\]

Where,

- \(a\) = Original mass in grams, of the test specimen
- \(b\) = Oven dry mass in grams, of the specimen

The differences in the resultant mean values of both types of cottons were evaluated by using Student's t-test at the significance level of 0.05.

The resultant values of moisture as depicted in Table VI, indicates towards the higher value of moisture content in organic cotton 9.89% than that of conventional cotton. Higher content of moisture content is directly related to lesser ash content, relating to low values of heavy metal ions and directly related to exposure to pesticides during cultivation.

**Determining the wax content**: Wax content is measured effectively using IS: 199 standard.

Chloroform was used as an extraction solvent. Soxhlet apparatus was used for carrying out this test. Three test specimens each weighing five grams for both types of cottons were treated with chloroform for 4 hours. By this process, chloroform solubilises the
wax and extract it out. This solvent was collected in a round bottom flask. Later solvent evaporates out and wax content was determined by using following formula:

\[
\text{Wax content percentage} = \frac{\text{Extracted matter}}{\text{Initial weight of fibeij}} \times 100
\]

Resultant mean values were compared by using Student's t-test.

This analysis step of invention revealed the lesser percentage of Wax content in organic cotton (0.64%) significantly lower than conventional cotton (0.81%), as shown in Table VI. The wax in the primary wall is a source of the hydrophobic nature of the un-scoured cotton (Etters, 1999). The higher value of wax present in conventional cotton may contribute to more hydrophobic tendency than organic cotton. The lower wax content in organic cotton indicates better absorbency and softness, in turn related to better hand feel, absorbency and better dye ability than conventional cotton. Lower wax content in organic cotton is an important factor to understand the better absorbency and feel of organic cotton fabric.

**Table VI: Estimation of Moisture, Ash and Wax content**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td>Organic</td>
<td>9.89</td>
<td>1.06</td>
<td>0.647</td>
</tr>
<tr>
<td>Conventional</td>
<td>9.78</td>
<td>1.25</td>
<td>0.818</td>
</tr>
</tbody>
</table>

**Determining the heavy metal content:** Heavy metals are the dense chemical elements such as cadmium, chromium, copper, lead, manganese, mercury, nickel and zinc. They can be toxic when highly concentrated. These groups of elements are present in the soil and the environment from natural and anthropogenic sources and can produce toxic effects if enter into the human food chain in high concentrations. The presence of heavy metals in the fibers is expected to come through the soil. The method of the invention measures the presence of heavy metals in both types of cottons and their establishes their relationship with the pesticides and fertilizers used in cultivation.

Atomic Absorption Spectrophotometer GBC-906 AA (Australia) was used to determine presence of Heavy Metals like Cobalt, Iron, Nickel, Copper, Cadmium, Lead, Calcium and Chromium in both types of cotton fiber samples. The resultant values were compared in terms of percentage difference in the metal concentrations.
EXAMPLE-2

DETERMINATION OF PHYSICAL PROPERTIES OF COTTON FIBERS:

Cotton fabrics are accepted worldwide due to its superior physical properties. The present also analyses the impact of cultivation methods on the physical properties of cotton fibers. The physical properties studied and analysed are fiber length, micronaire value, elongation and uniformity of organic and conventional cotton fibers, using Spin Lab HVI 900 Equipment. These tests for fiber properties were conducted as per ASTMD: 5867 standard as given below:

(a) Fiber bundle strength: Fiber bundle strength was determined using Stelometer (3mm) in Gm/tex as per ASTM D: 5867 Standard. The comparative assessment of the differences in the resultant means of both the cottons was evaluated statistically using Student's t- test at the significance level of 0.05, using SPSS for Windows 98.

(b) Fiber Maturity: Fiber maturity was tested as per IS:236 Standard in terms of maturity coefficient. The results were evaluated in terms of percentage differences in the maturity coefficient for both the cottons.

(c) Trash content: Trash content was determined as per IS:3674 Standard and results were evaluated in terms of percentage difference.

The results of this analysis shows that organic cotton fibers have improved length (27.87) than conventional cotton (27.60), improved strength (23.75%) than conventional cotton (19.70%) (ICAC Recorder, 1994) expressed that the absence of defoliants and desiccants in the crop (which makes the crop mature early, including forced opening of the late formed bolls) should have a favorable impact on the fiber quality in the form of better uniformity, fineness, maturity, staple length, elongation and fiber strength. Since the defoliants were not used during organic cotton cultivation,

<table>
<thead>
<tr>
<th>Heavy Metals</th>
<th>Organic (Mg/kg of fiber)</th>
<th>Conventional (Mg/kg of fiber)</th>
<th>Percentage difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobalt</td>
<td>0.013</td>
<td>0.026</td>
<td>50.00</td>
</tr>
<tr>
<td>Iron</td>
<td>0.093</td>
<td>0.330</td>
<td>71.81</td>
</tr>
<tr>
<td>Copper</td>
<td>1.690</td>
<td>3.160</td>
<td>46.51</td>
</tr>
<tr>
<td>Lead</td>
<td>4.06</td>
<td>5.92</td>
<td>31.41</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.054</td>
<td>0.130</td>
<td>58.46</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5.909</td>
<td>9.566</td>
<td>38.21</td>
</tr>
</tbody>
</table>
the better fiber properties of organic cotton fibers is because of the elimination of
defoliants.

The results of this analysis also show that the percentage of mature fibers in
organic cotton (2002-2004) was found between 61 to 72%, comparatively much higher
than conventional cotton fibers (55.2%). The maturity coefficient of organic cotton
fiber (0.82-0.84) was higher than that of the conventional cotton fiber. It has been
reported in Ahmed, N. (1924-41) (Technological Research on Cotton in India. Indian
Central Cotton Committee Technological Laboratory, Bombay), that fiber maturity is a
genetical factor which is influenced to a considerable extent by the conditions of
cultivation, such as the amount of irrigation, date of sowing, locality, spacing between
the plants and methods of manuring. Same established that, cow or sheep dung based
manures with top dressing has beneficial effects upon fiber maturity. As in the present
invention, the amount of irrigation, soil and climatic conditions, date of sowing and
spacing were all similar for both the cottons, therefore it can be concluded that the
better fiber maturity of organic cotton fiber is due to the type of manures (cow dung
with top dressing) used during cultivation.

The micronaire value of organic cotton (3.58-4.8) is higher than conventional
cotton (3.5). Similarly when % elongation was compared, it was found that the
elongation % of organic cotton is slightly higher than conventional cotton. It is explicit
from Tables VIII and IX that organic cotton has better physical properties than
conventional cotton.

TABLE VIII: Comparative Analysis of Fiber Physical Properties

<table>
<thead>
<tr>
<th>Fiber Type</th>
<th>Length (mm)</th>
<th>Strength (Gm/tex)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.5 % length (mean)</td>
<td>50 % span length (mean)</td>
</tr>
<tr>
<td>Conventional</td>
<td>27.60</td>
<td>13.8</td>
</tr>
<tr>
<td>Cotton I</td>
<td>27.89</td>
<td>14.11</td>
</tr>
<tr>
<td>Organic Crop II</td>
<td>27.53</td>
<td>13.60</td>
</tr>
<tr>
<td>Organic Crop III</td>
<td>27.87</td>
<td>13.96</td>
</tr>
</tbody>
</table>
### TABLE VII: Comparative Analysis of Fiber Physical Properties

<table>
<thead>
<tr>
<th></th>
<th>Maturity fiber %</th>
<th>Half mature %</th>
<th>Immature fiber %</th>
<th>Maturity coefficient</th>
<th>Fineness (micronaire value)</th>
<th>Elongation %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional cotton</td>
<td>55.2</td>
<td>26.6</td>
<td>18.2</td>
<td>0.78</td>
<td>3.50</td>
<td>5.4</td>
</tr>
<tr>
<td>Organic Crop I</td>
<td>64</td>
<td>16.3</td>
<td>19.7</td>
<td>0.82</td>
<td>3.58</td>
<td>6.5</td>
</tr>
<tr>
<td>Organic Crop II</td>
<td>61.2</td>
<td>26.1</td>
<td>12.7</td>
<td>0.82</td>
<td>3.5</td>
<td>5.2</td>
</tr>
<tr>
<td>Organic Crop III</td>
<td>72.2</td>
<td>20.8</td>
<td>7.0</td>
<td>0.87</td>
<td>3.5</td>
<td>5.8</td>
</tr>
</tbody>
</table>

**MAIN ADVANTAGES OF THE INVENTION:**

1. The invention provides a standard method to test physico-chemical properties of the two cotton specimens to understand the direct impact of their cultivation methods on their inherent composition. Conducting these tests processes in sequence, one can differentiate between organically grown cotton and conventionally grown cottons.

2. This present invention sufficiently provides supporting data to claim that this process disclosed in the present invention can be standardized industrially to differentiate between organically and conventionally grown cottons.

3. The method of the present invention can be standardized and utilized worldwide to acclaim the right fiber identity and authenticate the organic cotton fibers and textiles for trade purposes.

4. Another benefit of the method disclosed in the present invention is that it can be employed on any variety of cottons available worldwide provided both organically grown and conventionally grown cottons should be of the same variety to evaluate the differences statistically and authentically as different varieties of cottons behaves differently with non-similar climates and cultivation practices.
We claim:

1. A method for identifying the origin of cotton fiber by:
   (a) determining a set of chemical properties of said cotton fiber wherein said set of chemical properties are selected from the group comprising ash content, moisture content, wax content, heavy metals content or combination thereof; and
   (b) determining a set of physical properties of said cotton fiber wherein said set of physical properties are selected from the group comprising fiber length, fiber bundle strength, fiber maturity, fiber elongation, trash content, tensile strength, fiber uniformity, micronaire value or combinations thereof;
   (c) correlating the obtained physical properties and chemical properties with the method of cultivation to identify the origin of said cotton fiber.

2. The method as claimed in claim 1 wherein said method of cultivation is organic agricultural method or conventional agricultural method.

3. The method as claimed in claims 1 or 2 wherein cotton fiber is organic cotton fiber or convention cotton fiber preferably of the same variety.

4. The method as claimed in claim 3 wherein organic cotton fiber has no pesticide content.

5. The method as claimed in claim 1 wherein said set of chemical properties comprises:
   (a) determining the ash content of said cotton fiber;
   (b) determining the moisture content of said cotton fiber;
   (c) determining the wax content of said cotton fiber;
   (d) determining the heavy metal content of said cotton fiber.
6. The method as claimed in claim 5 wherein the organic cotton fiber has low ash content, low wax content, low heavy metal content and high moisture content than the convention cotton fiber of the same variety.

7. The method as claimed in claims 5 or 6, wherein said ash content, wax content, and moisture content in said cotton fiber is determined as per the recommended IS: 199 Standard test.

8. The method as claimed in claims 5 or 6, wherein said heavy metal content is determined by Atomic Absorption Spectrophotometer.

9. The method as claimed in claim 8, wherein the heavy metals are selected from the group comprising Cobalt, Iron, Nickel, Copper, Cadmium, Lead, Calcium and Chromium.

10. The method as claimed in claim 1 wherein said set of physical properties comprises:
    (a) determining the fiber length;
    (b) determining the fiber bundle strength;
    (c) determining the fiber maturity;
    (d) determining the micronaire value.

11. The method as claimed in claim 10 wherein the organic cotton fiber has high fiber length, high fiber bundle strength, high fiber maturity, high micronaire value than the convention cotton fiber of the same variety.

12. The method as claimed in claims 10 or 11, wherein the said physical properties are determined as per the ASTM D: 5867 standard by using Spin Lab HVI 900 Equipment such as hereinbefore described.

13. A method for identifying the origin of cotton fiber by:
    (a) determining the amount of pesticides in said cotton fiber;
    (b) determining the physical and chemical properties of said cotton fiber; and
(c) assessing said cotton fiber against said physical and chemical properties to
identify the origin of said cotton fiber.

14. Use of the method as claimed in any of the preceding claims for the
identification, segregation, authentification and/or certification of the
organically grown cotton fiber from conventionally grown cotton fiber.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01N33/36

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)
G01N

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

Electronic database consulted during the international search (name of database and, where practical, search terms used)
EPO-Internal, WPI Data, INSPEC, COMPENDEX, FSTA, BIOSIS, MEDLINE, EMBASE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>BLAISE D: &quot;Yield, boll distribution and fibre quality of hybrid cotton (Gossypium hirsutum L.) as influenced by organic and modern methods of cultivation&quot; JOURNAL OF AGRONOMY AND CROP SCIENCE, vol. 192, no. 4, August 2006 (2006-08), pages 248-256, XP002514592 ISSN: 0931-2250 abstract; table 6 page 250, left-hand column, paragraph 3 page 252, paragraph FIBER. QUALITY</td>
<td>1-14</td>
</tr>
</tbody>
</table>

X Further documents are listed in the continuation of Box C.

D 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 document but published on or after the international filing date
  "L1" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
  "P1" document published prior to the international filing date but later than the priority date claimed

Date of the actual completion of the international search | 12 February 2009 |
Date of mailing of the international search report | 25/02/2009 |

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Tel: (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Hani sch, Chris tia n
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
</table>
| Y        | CARCEA M ET AL: "Influence of growing conditions on the technological performance of bread wheat (Triticum aestivum L.)"
INTERNATIONAL JOURNAL OF FOOD SCIENCE & TECHNOLOGY,
vol. 41(Suppl.2), 2006, pages 102-107,
XP002514593
ISSN: 0950-5423
abstract
table 2 | 1-14 |
| A        | GUNDERSEN V ET AL: "Comparative investigation of concentrations of major and trace elements in organic and conventional Danish agricultural crops. 1. Onions (Allium cepa Hysam) and peas (Pisum sativum Ping Pong)"
JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY,
vol. 48, no. 12, December 2000 (2000-12),
pages 6094-6102, XP002514594
ISSN: 0021-8561
abstract; tables 3-6
page 6095, left-hand column, paragraph 1 | 1-14 |