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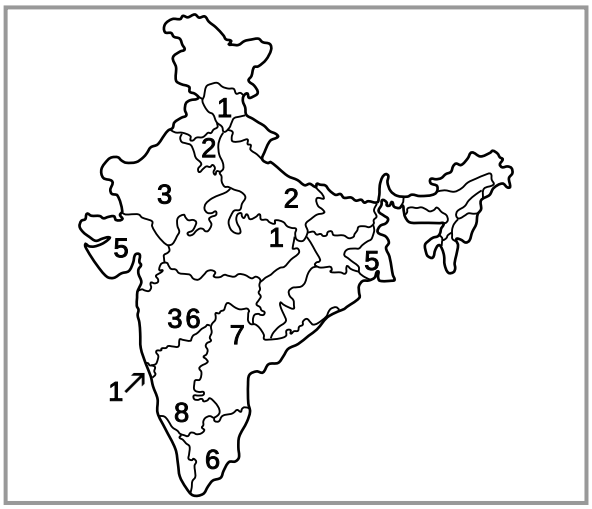

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Indian Micro-Fertilizers Manufacturers Association
201, 2nd Floor, Shrikrishna Apartments,
39/A, Gultekadi, Market Yard Road,
Opp. Apsara Theatre, Pune - 411 037
Telefax - +91- 20 - 2644 4759, 2644 6864
Mobile : +91 9422318857/ +91 9422318858
E-mail - micro_asso_india@yahoo.co.in
micro.asso.india@gmail.com, contact@imma.co.in
Web Site : http://www.imma.co.in
Editor: Pradeep Chitnis

FROM THE EDITOR'S DESK

Dear Readers,

This issue gives you importance of Boron in horticultural crops, its sources, deficiency sysmptoms and remedial measures for over coming the deficiency symptoms in various crops.

It also gives the foresight that organics farming alone cannot help to fulfil the demands of the increasing needs.

Editor

Invitation for Technical Data

We are publishing **'IMMA News'** Bulletin every Quarter with Technical Data on Fertilizers in general and Micronutrient Fertilizers in particular. We do forward the same as an complimentary to the Agriculture Scientists & officers, all over India.

We request all the readers to please send us Technical matter to be published in our **'IMMA News'**, which will assist the extension officers to disseminate your ideas to farmers, to increase crop yields.

The **'IMMA News'** Bulletin is also available on our web site http://www.imma.co.in

Role of Boron in Horticultural Crops

Dr. Raju Lal Bhardwaj
SMS (Horticulture) Krishi Vigyan Kendra, Sirohi (Rajasthan) India

Green plants are autotrophic in the sense that they are independent of external source of organic substances. They require inorganic matter from external and synthesize their own organic matter. Nutrition management of horticultural crops is one the important cultural practice to improve the productivity of fruits and vegetables in India. Analysis of plant reveals the presence of a large number of mineral elements. The amount of elements present in plants may also differ from plant to plant, place to place and medium to medium in which they grow. Approximately sixty different minerals have been reported from plants, out of which 30 elements are present in all plant and the rest are present in some plants. Out of 30 elements, 16 are essential for horticultural crops. Amongst the essential elements, boron plays an important role in all the horticultural crops. Boron occurs in the soils in extremely small quantities. Most of the available boron in humid region is held largely in the organic matter and is released by the microbial decomposition of organic matter for the use of the plant. Availability of boron decreases due to intensive cultivation. The high soil pH also causes boron deficiency in plants forming complex compounds. Availability of boron is optimum in pH range of 5.0 to 7.0, but maximum Indian soils are alkaline in nature. Several physiological disorders have been reportedly produced by boron deficiency in horticultural crops.

Source of Boron:

Boron occurs in rocks and marine sediments. It is absorbed in the form of borate ions and it has some sort of antagonism with calcium, potassium and other cations. ?

S. No.	Name of fertilizer	Boron per cent	Water solubility
1	Borax	10.60	Yes
2	Sodium penta borate	18.00	Yes
3	Fertilizer borate-46	14.00	Yes
4	Boric acid	17.00	Yes
5	Colemanite	10.00	Low
6	Solubor	20.00	Yes
7	Single Super phosphate	0.18	Yes

Function of Boron:

To boron, at least 18 roles have been assigned in different horticultural crops. It is necessary for translocation of sugars and involved in reproduction and germination of pollens. It is concerned with water reaction in cells and regulations the intake of water into the cell. It tends to keep calcium in soluble form within the plant and may act as a regulator of potassium cations. It may be concerned with nitrogen metabolism and with oxidation-reduction equilibrium in cell. Boron is essential for meristematic activity and in deficient plant, there is inhibition of calcium assimilation. It is

essential for the formation of root nodules in leguminous crops. Boron also regulates active salt absorption, fat metabolism, hormone metabolism and photosynthesis.

Deficiency symptoms of Boron:
The characteristic symptoms of boron deficiency are the death of the shoot tips, partial defoliation and dieback of the twigs and branches. Fruits are malformed and misshapened. Development of corky area in the fruit cortex and browning in the core regions.

Cracking and roughing of the stem. Splitting of the bark and development of different physiological disorders in horticultural crops like, internal necrosis in mango, fruit necrosis in aonla, fruit cracking in pomegranate, lime and litchi, roscetting and internal cork in apple, hollow stem of cauliflower, browning of cauliflower curd and hard fruit of citrus etc.

1. Boron deficient plants are dwarf, stunted with apical meristematic blackened and die back followed by general breakdown of meristematic tissue.
2. Terminal leaves become necrotic and shed premature.
3. Leaves show deficiency symptoms like appearance of white stripe, scorching, pimpling, splitted midrib, reduced growth and distortion like cupping and curling.
4. Stem shows deficiency symptoms like die back of apex, abnormal tillering, appearance of various forms of deformities such as curling and brittle lesion, pimpling etc.
5. Flowers are produced in lesser number and sterile.
6. Fruit when affected are severely deformed and useless.
7. Yellowish or chlorosis, which starts from base to tip. Tip elongates into a whip like structure and becomes brownish or blackish, leaves become thick and margin roll upward.

Corrective measures of Boron deficiency
In boron deficient soils, liming should be avoided and at times boron-containing fertilizer should be supplied.

1. Apply borax at the rate of 10-15 kg per hectare depending on the type of the soil, the soil reaction and the extent of the deficiency.
2. Boron deficiency may be controlled by foliar spraying of 0.2-0.4 percent borax - two to three sprays @ 10 to 15 days interval.
3. Apply well-decomposed compost one month before crop sowing @ 200 -300 quintals per hectare.
4. Timely soil reclamation and maintenance of soil pH at neutral (7.00).

Physiological disorder in horticultural crops:
1. Internal necrosis in mango: It is characterized by the appearance of dark green colour in lower half of the fruit followed by browning of the seed and mesocarpic tissue. The brown tissues then turn into brown or black necrotic lesion, which later on extend towards the epicarp. At advanced stage, complete lower half of the fruit turns necrotic and results into longitudinal cracking of the fruit in the necrotic region exposing the seed.

Control measures:

1. Langra variety is free from internal fruit necrosis.
2. Integrated nutrient management by

use of organic manure in the month of January.

3. Two to three sprays with borax 0.2 to 0.4 per cent at fruit development stage.

2. Interal fruit necrosis of Aonla: This disorder is characterized by browning of inner most part of mesocarpic tissue at the time of endocarp hardening followed by browning of the epicarp resulting in brownish black areas on the fruit surface. Depending upon the severity of the disorder, mesocarp of affected fruit turns black and become corky thereafter gummy pockets develop.

Control measures:

1. Spray of 0.6 per cent borax three times in the month of September and October @ 10 to 15 days interval.
2. Proper nutrient management of the orchard by well decomposed organic matter.

3. Fruit cracking in Pomegranate: Fruit cracking is the most serious physiological disorder in pomegranate. In young fruits, this disorder is due to boron deficiency but in fully grown trees it is due to moisture imbalance conditions resulting from irregular irrigation or rains.

A dry spell patch followed by heavy irrigation or rain results in peel cracking. The cracked fruits are infested by different microorganism and 25 to 90 % fruits are damaged.

Control measures:

1. Spray borax @ 0.1 per cent or calcium hydroxide on leaves and fruit after fruit set.
2. Maintain soil moisture
3. Growing fruit cracking tolerant cultivars like Bedana Bosec, Khog etc.

4. Fruit cracking in Litchi: The various factors associated with fruit cracking in litchi are boron deficiency, increased irrigation interval due to hot winds, endogenous levels of growth regulators, higher levels of gibberllins and abscisic acid in the skin, aril and seed. Market value and self-life of fruits are reduced drastically due to this.

Control measures:

1. Spray with boron 0.4 % at the pit hardening stage of fruit reduces the incidence.
2. Growing fruit cracking tolerant cultivars like Dehradun.
3. Maintain soil moisture properly.

5. Fruit cracking in Lime: Boron deficiency increases fruit cracking in lime. 20 to 80 % fruits are cracked before ripening at the stage of fruit development. Juice content is also reduced.

Control measures:

1. Spray Borax @ 0.1 % on leaves and fruits at fruit development stage.
2. Maintain soil moisture

6. Coulure, Millerandage, Shot berries and Hen and Chickens in grape: Boron deficiency results in development of mottle chlorosis from the leaf margin, leaves become necrotic upon coalescece of chlorotic patches. It also leads to drop of unopened buds and flowers resulting into poor berry set, referred as coulure. Development of small, seedless berries in compact bunches which is attributed to poor pollination and deficiency of boron.

Control measures:

1. Proper orchard management.
2. Fruit thinning at development stage.
3. Spray of 0.6 % borax, three times in the month of February and

March at about 10 to 15 days interval.

7. Hard fruit of Citrus: Symptom like die-back of tip, with reduced flowering and shedding of fruits. The fruits are misshaped, thick skinned and impregnated irregularly by gum around the central axis.

Control measures:

1. Apply borax at the rate of 30-50 g per plant with 25 kg organic manure.
2. Spray of 0.25 per cent borax twice at the fruit development stage.

8. Heart rot of Sugarbeet and Marigold: The most important symptom is the necrosis of the interior root. The youngest leaves are curled, veins become yellowish and petioles are brittle. The main growing point dies.

Control measures:

1. Proper nutritional management in field with application of organic manure.
2. Spray borax at the rate 0.2 per cent at initial stage of the crop.

9. Brown rot or Red rot of Cauliflower: This is a boron deficiency disorder in which water soaked areas are developed in the stem and at the centre of the branches of curd.

Control measures:

1. Apply borax at the rate of 10-15 kg per hectare depending on the contents in the soil.
2. Foliar application of the borax at the rate of 0.2 per cent.
3. Decrease soil pH to a value 7.0 by use of soil reclamation method.

10. Hollow stem of Cauliflower: Hollow stem may be due to boron deficiency and higher supply of nitrogen. At the later stage of the plant growth, the stem becomes hollow and surrounded by water soaked and discoloured tissue.

Control measures:

1. Spray of borax at 0.1 to 0.3 per cent at growth stage.
2. Soil application of the borax can also be done

11. Fruit cracking of tomato: This disorder in tomato is commonly observed during rainy season. Green and fully ripened fruits are liable to cracking. Fruits develop crack either radial or concentric type

Control measures:

1. Harvest the fruits before full ripening stage.
2. Supply sufficient soil moisture throughout growing season of the crop.
3. Spray borax at 0.3 to 0.4 per cent on tomato seedling in nursery just before transplanting and repeat the spray 3 to 5 weeks after transplanting. Third may be done at the same interval if needed.

12. Crown rot or heart rot of beetroot: This is due to boron deficiency in soil. Die-back in central leaves and blackening. Root, may turn black on the inside and the conkerd on the outside.

Control measures:

1. Avoid plantation in too sandy and poor soil.
2. Apply borax before sowing at the rate of 20 kg per hectare.
3. Apply well-rotted compost.
4. Avoid over liming the soil because it creates boron deficiency.

Organic farming - can it give food security to India?

Dr. C. V. Mali
Head, Department of Soil Science and Agril. Chemistry M. A. U, Parbhani. (M.S.)

The roots of organic movement in India go to the statement of B. Vishwanath (1937) that organic manure is the life of Soil and if neglected the fertility of Soil would not be maintained. Similarly, Howard (1940) believed that shifting from nature's method of crop production to improved methods, leads to the loss of soil fertility. This retrogressive thinking sowed the seeds of organic movement in India with great emphasis on the use of compost and other organic sources of plant nutrients. Apart from this, in modern agriculture the use of imbalanced chemical fertilizer without soil testing is reprehensible to encourage the movement.

Organic farming depends on use of crop residues, green manuring, off farm wastes, crop rotation, animal manures and biological pest control to maintain soil productivity (Palaniappan and Annadurai, 1999). The philosophy behind this is to feed the soil rather than the crop to maintain soil health. Thus, Hegde et al. (1995) have rightly pointed out that we have to exercise caution against extremism in organic farming that totally exclude the use of synthetic chemicals in farming.

There are several incarnation of organic farming that includes use of horses for tillering the land, Rishi Krishi, do nothing in agriculture, natural farming, Cow - horn technology, application of fertilizers with the ascendance of moon and Agnihotra as complete plant food though it contains mainly potash.

During the Era of green revolution, spectacular increase in crop yield resulted primarily due to introduction of high yielding varieties and increase in area under irrigation. A rationalist organic farming approach was needed to strengthen the pillars of green revolution; in order to have ever green revolution, however each being promoted primarily aiming at demolishing the pillars of green revolution. Therefore Chhonkar (2003) is of the opinion that the scientific community must not tolerate the absurdities in organic farming and treat them with contempts' they deserve.

The Organic food and organic agriculture is being increasingly talked about that organic foods are somehow superior, safer and more nutritious than the foods grown in the conventional way. Consumers are given belief that organic foods are superior because (a) they are safer as no pesticides and fertilizers have been used; (b) they are more nutritious as grown naturally; (c) serve the larger cause of safer environment; (d) being organic and naturally grown taste better; and (e) makes agriculture sustainable. Thus, the growers and consumers of organic farming believe that organic farming is indeed a sustainable agriculture.

But the protagonists of organic farming have not really addressed the issue through Scientific Validation and whether organic farming can meet India's food needs and provide sustainable food security. Can organic agriculture substitute modern farming system for

food security? The answer is an emphatic 'No.' Considering that the National food Security mission aims to produce an additional 10 million tonnes of rice, 8 million tonnes of wheat and 2 million tonnes of pulses by 2011-12 and given the vast diversity of crops, regions and pest complex in the country. It is clear that India needs a better crop protection approach. Thus, there is a need to extend and intensify the use of modern scientific techniques in agriculture - including the judicious use of pesticides – to meet national consumption requirements and ensure food security.

According to the Annual Economic Survey, the growth rate of agriculture was reduced in 2007-08 as against the previous year's growth of 3.8 per cent. The Survey further indicated a fall in food grain production by 2.2 million tonnes in 2007-08. Food is definitely going to be costlier as current production cannot match the rising population. In fact, during 1990-2007, the growth rate of food grain production decelerated to 1.2 per cent, significantly below the annual population growth rate of 1.9 per cent. During the period 2000-01 to 2006-07 actual production of food grains, pulses and oilseeds was 93 per cent, 87.7 per cent and 85.3 per cent of the target, respectively.

Population growth combined with declining yields has thus increased pressure on Indian agriculture, calling for higher balanced use of fertilizers and pesticides to improve yields. Dwindling stocks in India compelled wheat import during 2008-09 – despite a projected record harvest of over 76 million tonnes. Scientific opinion is unanimous in its finding that organic cultivation offers no solution to the world's hunger for foods. This is based on empirical realities tested in various parts of the world. Some of these observations are as follows -

Organic food is safer because no pesticides and fertilizers used.

Dr. Ruth Kava, Director of Nutrition, American Council on Science and Health in the foreword to the book “The Truth about Organic Foods” wrote, “Finally there is a book that credibly and dispassionately debunks the widely held belief that organic food is somehow safer and more nutritious, and that organic agriculture is environmentally superior to the conventional. 'The Truth about Organic Foods' separates organic industry spin from reality, using science and safety data gathered by government agencies and independent university scientists.” The studies conducted at University of Minnesota indicated (Journal of Food Protection, vol. 5, 894-900, May 2004), “The percentages of E. coli positive samples in conventional and organic produce were 1.6% and 9.7 %, respectively. Organic lettuce had the largest prevalence of E. coli (22.4 %) compared with other produce types.” The ABC NEWS 20-20: How Good Is Organic Food? February 20, 2000 reported, “The real bad news for the organic buyers is that the average concentration of E. coli in the contaminated [organic] spring mix was much higher. As per the Journal of the American Medical Association, (Medical News and Perspectives – January 8, 1997,277:97-98), “Experts say that increased consumption of organically grown, unprocessed foods produced without synthetic fertilizers, pesticides,

or preservatives may also be contributing to the problem of increased food borne illness. Robert V. Tauxe, chief of the CDC's food borne and diarrheal diseases branch noted that organic means a food grown in animal manure. Dr. Jim Senior scientist, Scottish Crop Research Institute in the Times Higher Education Supplement, (2003) reported that, "By not applying normal plant protection measures, such as fungicides, organic food would appear to be more at risk from mycotoxins contamination." Thus no conclusive evidence is presently available to prove that organically produced food is safer to eat than conventionally produced food. There is some anecdotal evidence of problems with the use of manure and food safety. Organic regulations recommend hay for animal feeding. Hay-fed animals infected with Escherichia coli strain 0157 incubate this dangerous organism longer than conventional animals fed on grain (Trewavas 2001). According to Berlau (1999) organic food is actually riskier than food grown with chemicals because of the way it is fertilized and organic food carries "quite a risk" If farmers use improperly composted manure.

According to Alex Avery (2006), "Despite this relatively low risk in historical terms, the available evidence is that the food safety risks from organic foods are significantly higher than those from conventional foods. Food borne bacterial risks are significantly higher in organic produce, as are fungal toxin risks. These higher risks have been demonstrated by multiple independent studies by researchers that are both sceptical and friendly to the organic philosophy." The source of inputs, whether organic or inorganic is irrelevant. The question is: Are organic inputs available in the quantities required and do they work as swiftly and efficiently as the synthetics? Soluble mineral inputs are prohibited and synthetic herbicides and pesticides are rejected in favour of natural pesticides in organic farming. Such an approach results in a more costly product, mainly because of lower yields and inefficient use of land. This is aptly answered by Dr. Norman Borlaug, Nobel Peace Prize Laureate and Distinguished Professor of International Agriculture. He states: "That's ridiculous. This shouldn't even be a debate. Even if you could use all the organic material that you have – the animal manures, the human waste, and the plant residues and get them back in the soil, you cannot feed more than 4 billion people. In addition, if all agriculture were organic, you have to increase crop land area dramatically, spreading out into marginal area and cultivating millions of acres of forests. At the present time, approximately 80 million tonnes of nitrogen nutrients are utilised each year. If we try to produce this nitrogen organically, we will require additional 5 to 6 billion heads of cattle to supply the manure. How much land would you have to sacrifice just to produce the forage for these cows? There's a lot of nonsense going on here."

Organic food is More Nutritious

Lady Balfour one of the foremost and strongest proponents of Organic farming in 1977 admitted at an IFOAM conference that after more than 30 years of research she could find no nutritional differences between organic and conventional products. Dr. William Lockeretz, Professor, School of Nutrition Science and Policy, Tufts University (Proceedings of the 5th International

Federation of Organic Agriculture Movement's Conference on Trade in Organic Products, 1997) said that "I wish I could tell you that there is a clear, consistent nutritional difference between organic and conventional foods. Even better, I wish I could tell you that the difference is in favour of organic. Unfortunately, though, from my reading of the scientific literature, I do not believe such a claim can be responsibly made". Dr. Norman Borlaug, agronomist and 1970 Nobel peace Prize laureate; Reason Magazine, April 2000 was more forthright in generations.

"If people want to believe that organic food has better nutritive value, it's up to them to make that foolish decision; but there is absolutely no research that shows that organic foods provide better nutrition."

Serve the Larger Cause of Safer Environment?

On biodiversity, Stolze et al (2000) say that "organic farming clearly performs better than conventional farming in respect to floral and faunal biodiversity," but Stolton and Geier (2002) say that "organic farming systems are not always automatically sympathetic to biodiversity conservation." According to Borlaug (2002) there is a conflict between man – made biodiversity ("antique farmers' varieties") and the unique species characteristic of a wild forest that would, in Borlaugs view, have to be chopped down if low-yield agriculture were to prevail – with yield per acre falling due to organic farming, there would be wholesale depletion of forests to increase farming land. Trewavas (2001) is of the opinion that mechanical weeding, done more frequently on organic than on conventional farms, could damage nesting birds, worms and invertebrates. Organic farming may actually damage the land more than modern farming - as it requires more ploughing than fields where herbicides are used, and on some soils, repeated ploughing compacts deep layers of soil and reduces yields.

Organic farming generally results in lower or similar nitrate leaching rates than conventional agriculture (DEFRA 1999). However, Trewavas (2001) says that the ploughing in of legume crops (a necessary process on organic farms) and continued manure breakdown leads to nitrate leaching into aquifer and waterways at rates identical to conventional farms. According to Edwards-Jones and Howells (2000), pesticides and fungicides generally permitted for use on organic farms are less hazardous than those used in conventional systems but there are exceptions and some evidence suggests that when toxicity and volume are considered in an overall pest management strategy, organic practices have greater environmental hazard than conventional ones (Kovach et al 1992).

Organic food Taste Better?

Hundreds of rigorous tests have failed to show that organic foods taste better or have improved nutritional value however, there is some evidence that they have lower nitrate and protein content (Trewavas 2001: Woese 1997). The impact of organic food on human health is unknown and should be examined (Ewa Rembialkowska, Division of Organic Foodstuffs Warsaw Agri. Univ. Poland).

Organic farming Sustainable?

Organic production is sustainable - this contention is debatable. The terms 'organic farming' and 'sustainable agriculture' are used interchangeably in many circles, which is not necessarily true. Organic farming is not always sustainable and sustainable agriculture is not always organic. Plants cultivated in organic system have significantly lower yield: on an average 20 % lower than conventionally produced crops. The same holds true for animal production, where yield of milk and meat is significantly lower. It causes lower profit for the organic producer, increases the prices, and creates a barrier for many consumers from buying organic food (Ewa Rembialkowska, Division of Organic Food Stuffs, and Warsaw Agri. Univ. Poland).

Sustainable agriculture is a system that maintains or enhances agricultural production, reduces the level of production risk for the farmer, protects natural resources, is economically viable, and is socially acceptable. Considering these parameters or characteristics of sustainable system, the organic farming mode does not fulfil the requirements of sustainability. Organic farming doses not enhance production but increases production risks due to diseases and pests and the resultant produce is generally infected/substandard and risky for health. Long Term Fertilizer Experiments conducted under varied agro climatic conditions in the country have shown that balanced application of chemical fertilizers over a period of three decades sustained crop productivity and superior to application of only FYM in building carbon and fertility status of soils (Swarup and Wanjari, 2000).

A Transition period of 2-3 years is required to practice organic agriculture in India during which no inorganic fertilizers and agrochemicals are used on the farm and the produce is marketed. Further guidelines issued by Codex Alimentarius and IFOAM can create problems for exporters of organic produce. Developing country like India cannot afford to switch completely to organic farming. It will adversely affect food production, leading to increased poverty and malnutrition due to unavailability of food in the required quantity and at affordable prices. (Prem Kishore and Rajen Sundaresan, crop care, 47-53, 2008) In this context, it will be relevant to again quote Dr. Borlaug who said, “Switching on food production to organic would lower crop yields. We can use all the organics that are available but we are not going to feed six billion people with organic fertilizer or materials.” Thus organic farming is possible only in a limited area. (Source: Handbook of Agriculture, 2006, ICAR, New Delhi). At a time when the country is going through difficult food situation, resorting to imports, it is the responsibility of our Policy Planners, Agricultural Scientists and Extension Managers to ensure that every effort should be made to increase our food production to meet the projected targets of food production. Modern agricultural technology with scientific inputs like judicious use of pesticides and fertilizers only will help our nation to achieve food security and thereby help our farmers to improve their economic well being.