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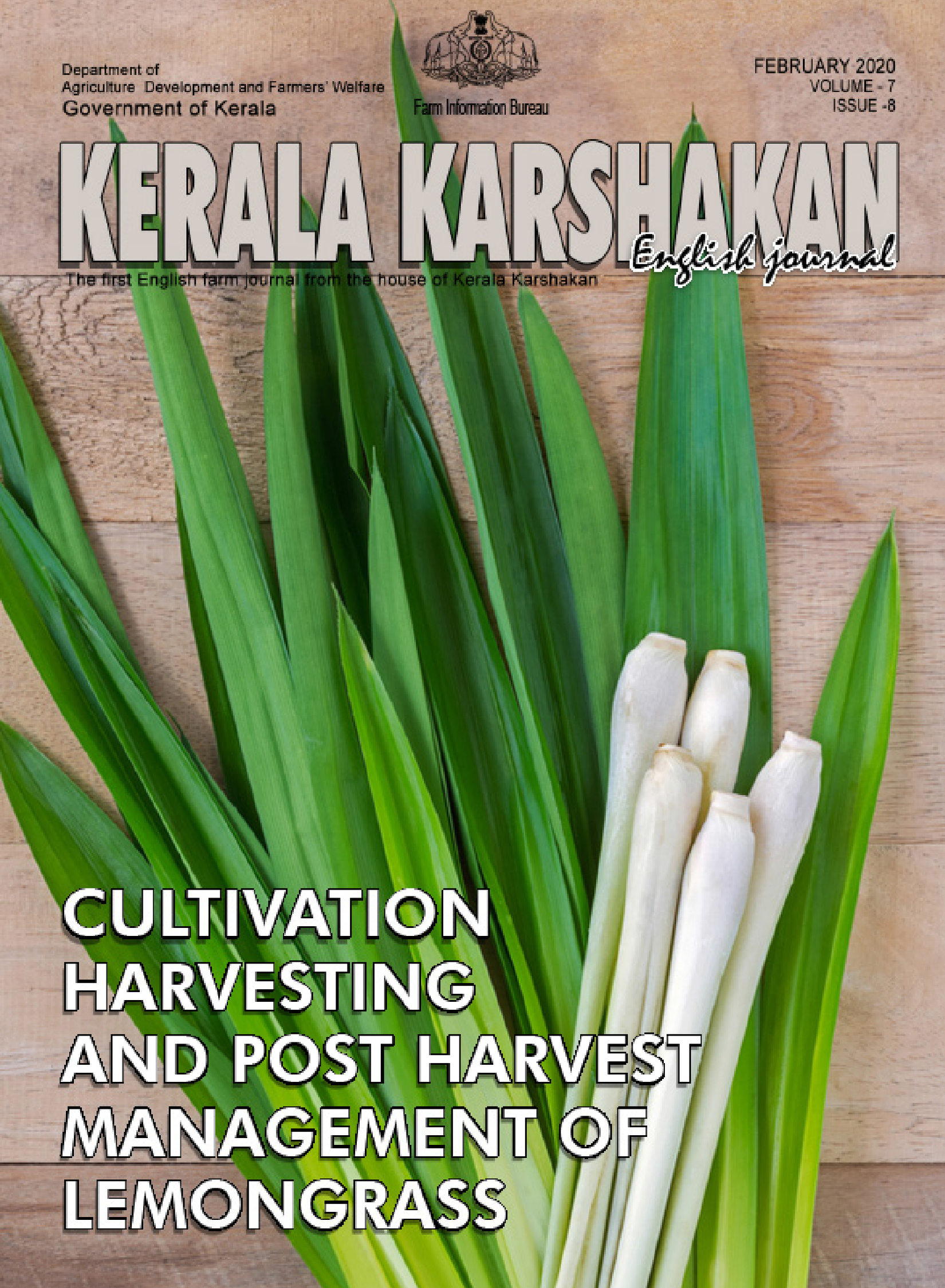
The first English farm journal from the house of Kerala Karshakan



CULTIVATION HARVESTING AND POST HARVEST MANAGEMENT OF LEMONGRASS

INSIDE

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NUTRIENT DISORDER DUE TO BORON IN TROPICAL TUBER CROPS

Symptoms and Corrective Measures

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Plate 1: B deficiency symptom in cassava leaf (from cassava germplasm at ICAR-CTCRI)

Nutrient management is one among the most important strategies required for crop production. The 17 elements essential for crop growth and yield can be classified as primary, secondary and micronutrients. Nitrogen (N), phosphorus (P) and potassium (K) constitute the major and calcium (Ca), magnesium (Mg) and sulfur (S) forms the secondary group of nutrients. Micronutrients of importance to the major soil type of Kerala viz., Laterites include iron (Fe), copper (Cu), manganese (Mn), zinc (Zn) and Boron (B). Since, Fe and Mn are abundant in laterite soils, their deficiency is not usually seen in these soils. Moreover, as per the investigations of the project coordinated by Kerala State Planning Board on the fertility evaluation of Kerala soils, it is stated that, the deficiency of Zn and Cu also is not that significant. In general, it can be said that, the laterite soils of Kerala are acidic with pH ranging from 4.5 - 5.5, organic carbon content ranges from low to medium to high, N and K is in the low to medium range, P is very high in 90%, Ca and Mg are deficient while S is sufficient in most of the soils. Among the micronutrients, only B is seen deficient in 60-80% of the areas. Manifestation of B deficiency in crops started appearing in recent times, though there are reports on the deficiency due to B in coconut since several years. It is clearly known that, Ca, B and S are immobile in the plant system and hence, the nutritional disorders are usually manifested in younger growing regions. We know that, during the olden days, huge quantities of organic manures were used in crop production, thereby the deficiencies of these nutrients especially micronutrients were not that much remarkable. This was further aggravated by the intensive cultivation through growing of more crops in the same land continuously without giving much importance to balanced fertilization/ integrated nutrient management (INM) practices involving organic manures, chemical fertilizers and bio fertilizers. These type of unscientific cultivation practices involving non judicious application of inputs can definitely lead to nutrient deficiencies particularly that of micronutrients which in turn can lead to the expression of nutritional disorders in crop plants. Among these, the commonly found one is that of B deficiency in most of the crop plants. In addition, the excess availability of nutrients like P in laterite soils can hinder the availability of B too in these soils. The high availability of P and S in the laterite soils of Kerala can be attributed to the use of factomphos (N:P:K:S@20:20:0:13) which is manufactured in Kerala itself. As the uptake of P compared to N and K is very less to the tune of one tenth of N and K, the

Plates 3: B deficiency Symptoms manifested from farmers' fields in Kuttanad

applied P remains in the soil, being it is immobile and hence resulting in high P availability in laterite soils.

As in the case of other crops, tropical tuber crops like cassava, sweet potato and elephant foot yam also requires micronutrients. Among these, the deficiency of B deserves special mention during the past one decade as it has resulted in nutritional disorders both in leaves and tuber affecting the growth and yield of these crops.

B deficiency disorders in cassava

The picture below depicts the B deficiency disorder noticed in some plants of the cassava germplasm maintained at ICAR-CTCRI during 2016. It was manifested as crinkling and curling of the tender leaves at the stem apex giving a broom like appearance (Photo 1). The analysis of the samples collected from the symptomatic leaves indicated the B content in the leaves as 11 pppm which is very much below the leaf critical level of B in cassava (30-60 ppm). Similarly, the soil status of B was only 0.32 ppm which was also far below the soil critical level of B for cassava (0.5-1 ppm).

Plate 1: B deficiency symptom in cassava leaf
(from cassava germplasm at ICAR-CTCRI)

Hence, we could confirm the occurrence of the symptom as due to B deficiency in the soil. Similarly, we have received some similar reports with photos from the farmers' fields of Kuttanad. Based on the symptoms manifested it was understood the problem being B deficiency (Plates 2,3).

Plates 2,3: B deficiency Symptoms manifested from farmers' fields in Kuttanad

In addition to these symptoms, some visual symptoms in the form of breaking of the rind (Plate 4) which was first reported from Malappuram an year back. This was accompanied by hardening of the flesh as woody (Plate 5). Recently about one month back, another enquiry with the same symptom was reported from Malappuram.

Plate 4 : Breaking the rind of cassava tubers

Plate 4 : Breaking the rind of cassava tubers

Plate 5: Woody flesh of the cassava tuber

Plate 5: Woody flesh of the cassava tuber

Recently from Adoor of Pathanamthitta district also, a similar enquiry came and we have collected the leaf, stem and tuber samples and were analysed for B in addition to the investigation of soil samples for B. It is seen that, the B content in the leaf, stem and tuber were 13, 4.8 and 2.7 ppm respectively. The soil B content was found as 0.29 ppm. .

Corrective measures

Plate 7. Boron deficiency symptom in sweet potato tuber Corrective measures

The symptoms manifested by the plants in our germplasm collection could be overcomed by applying 0.1% boric acid along with 0.5% calcium nitrate as foliar spray @ 250-500 ml. per plant. Simultaneously, we have applied 2 g each of borax and calcium nitrate in soil too. This treatment could solve the problem within a fortnight. The cassava plant in plate 6 was the same plant in plate 1 after treatment which in turn resulted in recouping the symptom manifestation in the leaf.

Plate 6: After treatment of the same plant which exhibited the symptom

In those areas where symptoms were shown only in tubers were advised to apply borax/boric acid @10 kg/ha in soil and to follow the foliar application as indicated earlier or solubor 0.1-0.5% @ 250 ml. per plant at the maximum vegetative growth stage probably during the 5th month after planting and again two times of application at the above rate during the tuber bulking stage at 6th and 8th month of planting.

Boron deficiency in sweet potato

The soil critical level of B for sweet potato is 0.5-1ppm. The picture below is the tubers from the germplasm of sweet potato at ICAR-CTCRI. The symptom was manifested as breakage and splitting of tubers along with woody tuber flesh. The deficiency was confirmed as B by analysing both soil and plant tissues from affected areas. The soil status of B was 0.5 ppm and the B content in the leaves was 0.32 ppm where the critical level of B in sweet potato leaves was delineated as 0.4 ppm. Hence, the expressed symptom was confirmed as due to deficiency of B (Plate 7).

Plate 7. Boron deficiency symptom in sweet potato tuber

Corrective measures

The adhoc recommendation suggested for cassava can be done for sweet potato also. As regards to foliar application, the first application can be done two months after planting and two subsequent applications at 15 days interval can be followed as per the concentration indicated with a lower rate of upto 250ml per plant depending upon the vegetative growth of the crop.

Symptoms associated with excess boron application in tropical tuber crops

Based on the studies on micronutrient management of tropical tuber crops, it is understood that, boron is the micronutrient which is to be applied with utmost caution as the critical range between deficiency - sufficiency and toxicity is very narrow/marginal in the case of B. So, if we are applying this nutrient a little bit higher rate and dose, that will adversely affect the growth and yield of the crop.

Toxicity symptoms manifested in elephant foot yam

When there is excess B in the plant due to over concentration and over rate of application, the growth of the crop will be hindered by affecting the normal stature of the crop with deformed plant structure ultimately resulting in growth inhibition and hence adversely affecting the tuber yield (Plate 8).

Plate 8: Toxicity symptoms due to B manifested in elephant foot yam

Toxicity symptoms manifested in cassava

In cassava, application of B in soil and plant resulted in excess B content in the leaves causing the defoliation affecting the normal growth of the plant and incidentally the tuber yield (Plate 9).

Plate 9,10: Symptoms due to excess B in cassava

Research results related to soil test based boron application in cassava

Table 1 . Research results of B in cassava

Content of B in soil (ppm)	Rate of application of B (kg/ha)	Year	Soil status of B (ppm)	Rate of B applied (kg/ha)	Tuber yield (t/ha)	Tuber yield as per PoP (kg/ha)
<0.2	10	2012	0.49	7.5	-	-
0.2-0.5	7.5	2013	0.748	5	20.242	21.623
0.5-1.0	5	2014	0.852	5	25.910	25.173
1-2 2.5	2015	2.083	0		24.804	27.615
>2 0	2016	0.849	5.0		30.530	23.060
	2017	0.414	7.5		11.162	11.425
	2018		-		27.545	25.444

At ICAR-CTCRI, we have been experimenting the blanket dose of B @ 10kg borax per hectare since 2005 and there was no significant yield increase due to the application. Hence, from 2011, the standardised rate (Table 1) as per soil status was tried.

It was understood that, response to B could be obtained only the status of soil B is below the soil critical level which was revealed from the Table below (Table 1). Even though we have these types of results, as B is immobile in the plant system and in high P soils, due to the formation phosphoborate, the uptake of B is less, we cannot predict the response of crops to B. Hence, it is always recommended to use B for crops based on soil test and plant analysis or at least soil test.

Nowadays, the expression of B deficiency symptoms by annual and seasonal crops like banana and vegetables are rampant.

Through balanced application of nutrients by adopting integrated nutrient management (INM) involving organic manures, chemical fertilizers and bio fertilizers or by application of large quantities of organic manures, the deficiency problems due to micronutrients especially B can be avoided. In a State like Kerala, where the cultivable land area is limited and farmers are resorting to intensive farming either through multiple cropping or continuous cropping in the same field, it is inevitable to adopt INM so that the nutrient deficiency problems can be managed to a great extent.

Plate 10: Symptoms due to excess B in cassava

If any such deficiency disorders especially that of B is noticed, better to adopt the corrective measures suggested earlier.