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Effect of Potassium-Boron Content of Leaf on Copra Yield of Coconut (*Cocos nucifera* L.) in *Terai* Region of West Bengal, India

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A B S T R A C T

Wide spread potassium and boron deficiency in coconut (*Cocos nucifera* L.) is a limiting factor for increased nut production in *terai* region of West Bengal. Accordingly, an experiment was undertaken in a 7.5 m x 7.5 m spaced 11 years old coconut plantation (cv. ECT) laid out in Factorial randomized block design with 9 treatments and 4 replications with graded levels of potassium (900, 1200 and 1500 g of K_2O per palm) and boron (25, 50, and 100 g borax/palm) for two consecutive years (2014-15 and 2015-16) to study the influence of leaf potassium and boron on copra yield in coconut in the region. The leaf samples collected from the index leaf (14th frond) was taken for analysis of boron and potassium content at 6 and 12 months after soil application of both the nutrients. The results revealed that both leaf boron and potassium content increased significantly with increasing levels of applications. However, the intermediate dose of both the nutrients recorded the highest copra yield production (15.74 kg per palm per year or 2.72 tonnes per ha per year) when leaf potassium and boron were 1.97% and 24.52 mg/kg, respectively. With further increase in the rate of application of the nutrients, there was a decline in copra yield, despite an increase in the respective nutrient content in the leaves. The interaction effect also revealed the same trend. The copra yield production thus showed a positive correlation with increased content of leaf potassium and boron upto a certain level. And, both the nutrients produced a negative effect at 'more than optimum' doses in respect of copra yield.

Introduction

Since the last two decades, there has been a steady and consistent increase in the acreage under the cultivation of coconut (*Cocos nucifera* L.) in West Bengal. It is more so in the districts of North Bengal, where the palm is grown in homestead gardens, though the crop is gaining increasing importance of a plantation crop in the region. However, based on soils' inherent capacity to meet the plant's requirements, rational crop culture and nutrient management are very poorly practiced. Sandy soils, heavy rainfall, acidic nature of soil, nutrient removal by the crop, and leaching and percolation losses result in multiple nutrient deficiencies and makes the situation further complicated. Among the deficient plant nutrients in such coconut growing soils, potassium and boron are the most important. Both the nutrients play very significant roles in increasing the sizes of the nuts and copra biomass, enhance their softness, improve kernel development, help in translocation of starch from the leaves to the nuts, and increase the sweetness of the coconut water. Further, potassium helps regulating the plant's metabolism, closing and opening of the stomata required for water economy, acts as activator of many enzymes, maintains cation-anion balance of in the cell, and controls the transport of metabolites for cell division which in turn enhance the copra yield of coconut. Though such effects of the two nutrients are well known, studies on boron and potassium nutrition in coconut in the *terai* region of the West Bengal are not available.

Accordingly, the present investigation was undertaken to evaluate the effects of boron and potassium application to coconut in such soils and study their concentration in leaf and relate these concentrations to copra yield of the nuts.

Materials and Methods

The experiment was carried out during 2014-15 and 2015-16 at the Instructional Plots of the Department of Plantation Crops and Processing, Uttar Banga Krishi Viswavidyalaya, West Bengal. The experimental field is located at 43 m above mean sea level at 26°19$^{/}$86$^{//}$N latitude and 89°23$^{/}$53$^{//}$ E longitude. Physico-chemical properties of the soil analysed by standard methods were: texture- sandy loam, pH - 5.45 (Jackson, 1973), electrical conductivity - 0.06 dsm-^{1} (Jackson, 1973), organic carbon - 0.93% (Walkley and Black, 1934), available N - 159. 32 kg/ha (Subbiah and Asija, 1956), available P - 23.15 kg/ha (Bray and Kurtz, 1945), available K – 87.15 kg/ha (Jackson, 1967), and available B – 0.59 mg/kg (Hot water extractable as proposed by Berger and Truog (1939).

The experiment was laid out in Factorial Randomised Block Design with 9 treatments, with three different levels of potassium viz. K_1, K_2, and K_3 @ 900, 1200 and 1500 g of K_2O (as MoP, 60% K_2O) and three levels of boron viz. B_1, B_2, and B_3 @ 25, 50, and 100 g (as borax, 10.5% B) per palm per year at a spacing of 7.5 x 7.5 m in 9 years old East Coast Tall. Each treatment was replicated 4 times The nine different treatment combinations were as follows:T_1: $B_1K_{1:}$ 25 g borax/palm + 900 g K_2O/palm, T_2: $B_1K_{2:}$ 50 g borax/palm + 1200 g K_2O/palm, T_3:$B_1K_{3:}$ 25 g borax/palm + 1500 g K_2O/palm, T_4:$B_2K_{1:}$ 50 g borax/palm + 900 g K_2O/palm, T_5: $B_2K_{2\,:}$ 50 g borax /palm + 1200 g K_2O/palm, T_6: B_2K_3 50 g borax/palm + 1500 g K_2O/palm, T_7: $B_3K_{1\,:}$ 100 g borax/palm + 900 g K_2O/palm, T_8: $B_3K_{2:}$ 100 g borax/palm + 1200 g K_2O/palm and T_9: $B_3K_{3:}$ 100 g borax /palm + 1500 g K_2O/palm. All the palms were fertilized uniformly with 500 g N (as urea, 46% N) and 320 g of P_2O_5 (as SSP, 16% P_2O_5) per palm along with the required amount of boron and potassium as per the treatment combinations. Half of the doses of the nutrients were applied in May, 2014 as pre-monsoon application, while the remaining half was applied in September, 2014 as post-monsoon application. The same fertilizer schedule was repeated for the year 2015. The fertilizers were applied at 180 cm away from the base of the palms (De Silva, 1968). The initial soil samples at 0-30 cm depth were collected at random before commencement of the study; thereafter, sampling was done at 6 month intervals at a the same depth at sites 1.8 m away from the trunk of the palm. For the determination of boron and potassium content of leaf, the leaf samples were collected from the index leaf *i.e.* 14th fronds for analysis before application of the fertilizers and subsequently at 6 and 12 months after application. The 14th fronds were chosen as the index leaf for analysis of as suggested by Reuter and Robinson (1997). The leaf samples were digested by tri-acid mixture and the acid digests as such or after proper dilution were analysed for their potassium content by flame photometry as described by Muhr *et al.,* (1965). For determining boron, the digests were analysed by the method suggested by Berger and Truog (1939).

Results and Discussion

Effect of K and B application and their interactions on leaf K content in coconut growing soils

Results with respect to the effect of application of boron at different levels on leaf K content are presented in Table 1 and Figure 1 showed that there was not much variation in leaf K content between the two years. The results of the two years were thus fairly consistent. With increase in the level of boron from B_1 to B_2, there was significant increase in leaf K content. Thus, the leaf K content increased from 1.72 at B_1 level to 1.82 % at B_2 level at 6 months after application in the year 2014- 15. The increase in leaf K content thus increased with the additional supply of boron. Both B and K serve as buffers and are necessary for the maintenance of conducting tissues (Mengel and Kirkby, 2001).

This variation might be due to its maintenance of conducting tissues and cation – anion balance as a result of which cell membrane permeability to K^+ uptake was increased. Stimulation of the proton pump with subsequent hyper polarization of the membrane resulting in an increased driving force of K^+ influx may be another possible reason. Increased K uptake at an optimum level of soil boron has been reported by Samet *et al.,* (2015) in pepper. With further increase in boron level, the leaf K content however, decreased substantially from 1.82 % to 1.31 % in the change from B_2 to B_3 level in 2014-15. This decrease was to the extent of about 28 % and must be due to the toxic concentration of boron in the soil at B_3 level of boron application. This negative effect between B and K might have been caused by K efflux out of the roots due to the differential effect of B toxicity on plasma lemma permeability. Similar findings have been reported by Samet *et al.,* (2015) and Mengel and Kirkby (2001) reported that excess supply of boron in growth medium reduced uptake of K and *vice versa*.

The results pertaining to the effect of K applications at different graded levels on the leaf K content are also depicted in Table 1 and Figure 2 revealed that with increase in the level of potassium from K_1 to K_2, there was significant increased from 1.12 to 1.74 % in the leaf K content in 2014- 15. The functions of potassium as already stated earlier might have contributed to the increased leaf K content at a higher potassium level. With further increase in potassium level, there was further increase in leaf K content from 1.74 to 1.99 in 2014-15 from K_2 to K_3 and it may be because of ‘more than required absorption of K as coconut is a potassium loving plant as reported by Manicot *et al.,* (1980).

Increased requirement of K may also be due to its involvement in enzymatic activity, photosynthesis, stomatal movement, phloem transport, cation- anion balance and stress resistance (Marschner, 2012). The same trend of results was observed in 2015-16 and also in the case of pooled results for the two years. In any case, with increase in potassium supply, the nutrient continues to be increasingly absorbed as seen in increased leaf K content. This aspect is to be considered in coconut fertilisation for a high nut yield, since the absorbed K above a certain level does not give any additional yield. Venkitaswamy *et al., (*2011) also reported results in similar lines.

Interaction effects of boron and potassium application on leaf K content

The results revealed that the leaf K content was the highest in B_1K_3 treatment followed by B_2K_3 and B_2K_2 treatments, being 2.32 %, 2.21 %, and 1.96 % respectively and it was lowest in B_3K_1 followed by B_1K_1 and B_3K_3 amounting in the order of 0.97 %, 1.10 % and 1.43 % in respective treatments in 2014-15 (Table 1 and Fig. 3). The same trend was observed in the year 2015-16 and also for the mean of the two years. Boron-potassium interactions at the applied rates and combinations might have caused the differences in the leaf K content. The results of the study suggest that, there was synergistic interaction effect between K and B in the case of B_1K_3, B_2K_3, and B_2K_2 treatments resulting in increased K uptake.

The interaction between these two nutrients was antagonistic also in B_3K_1 and B_3K_3 combinations. Findings in similar line in on leaf K contents in boron-potassium combinations have been reported by Mengel and Kirkby (2001).

The authors observed that B and K interaction was negative with an excess of boron; boron toxicity in case of excess boron application decreased the uptake of K. It may be mentioned in this connection that Reuter and Robinson (1997) suggested 0.6, 0.6 to 0.9, and 1.2 to 1.5 mg/kg leaf (14^{th} leaf) K for confirming deficient, critical, and adequate ranges of potassium, respectively in coconut. Using these limits for ascertaining K deficiency or adequacy in coconut, it may be concluded that in the present study, the B_3 and K_1 levels and combined treatments of B_1K_1, B_2K_1, B_3K_1 were found to be in low range; further, B_1, B_2, K_2 K_3 levels and B_1K_2, B_2K_2 and B_3K_2 interactions were in sufficiency range, while, B_1K_3 and B_2K_3 interactions were found to be in the in excess or high range at 6 month after soil application of B and K. It may also concluded that, all the levels of boron and potassium and their interaction effects pertaining to leaf K content were showed progressively decreasing trend from 6 month to 12 months after soil application of boron and potassium, which might be attributed to consequent mobility of K ions from vegetative parts, such as the leaves, to the reproductive parts of the plants. These results are in tune with those of Harishkumar *et al.,* (1982).

Effect of application of boron and potassium and their interactions on leaf B content

Effect of boron application at different levels on leaf B content are presented in Table 2 and Figure 4 showed that with increase in the level of boron from B_1 to B_2, and from B_2 to B_3 there was significant increase in leaf boron content. B content in leaf increased from 14.09 to 22.58 and 22.58 to 30.79 mg/kg in respectively at 6 months after application in the year 2014-15.

The results further revealed that the increases in leaf B content were in proportion to the increases in the rates of application of boron. Similar results have been reported by Moura *et al.,* (2013) in coconut.

The results with respect to the effect of graded levels applications of potassium on the leaf B content are also presented in Table 2 and Figure 5 revealed that there was high consistency in leaf B content between the results of the two years. With increase in the level of potassium from K_1 to K_2, there was little increase in the leaf boron content from 23.63 to 23.78 in 2015-16 at 6 months after application and it was statistically at *par* with each other. With further increase in potassium level, there was sharp decrease in boron content of the leaves from 23.78 to 21.05 in 2015-16 and it was statistically significant.

Table.1 Effect of application of boron and potassium and their interaction on leaf K content (%) after 6 and 12 months of application

Levels of Boron	6 months (December)			12 months (June)		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
B_1	1.72	1.73	1.73	1.03	1.03	1.03
B_2	1.82	1.84	1.83	1.06	1.05	1.06
B_3	1.31	1.31	1.31	0.86	0.86	0.86
SE(m)±	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
LSD (P=0.05)	**0.02**	**0.01**	**0.01**	**0.02**	**0.03**	**0.02**
Levels of Potassium	**6 months (December)**			**12 months (June)**		
	2014-15	**2015-16**	**Pooled**	**2014-15**	**2015-16**	**Pooled**
K_1	1.12	1.12	1.12	0.86	0.85	0.86
K_2	1.74	1.75	1.75	1.03	1.03	1.03
K_3	1.99	2.00	2.00	1.06	1.05	1.06
SE(m)±	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
LSD (P=0.05)	**0.02**	**0.01**	**0.01**	**0.02**	**0.03**	**0.02**

Treatments	6 months (December)			12 months (June)		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
B_1K_1	1.10	1.10	1.10	0.83	0.83	0.83
B_1K_2	1.75	1.75	1.75	1.04	1.03	1.03
B_1K_3	2.32	2.33	2.33	1.22	1.22	1.22
B_2K_1	1.29	1.30	1.29	0.99	0.98	0.98
B_2K_2	1.96	1.97	1.97	1.10	1.10	1.10
B_2K_3	2.21	2.24	2.23	1.10	1.08	1.09
B_3K_1	0.97	0.97	0.97	0.75	0.75	0.75
B_3K_2	1.52	1.53	1.52	0.96	0.96	0.96
B_3K_3	1.43	1.44	1.43	0.85	0.86	0.86
SE(m)±	**0.01**	**0.01**	**0.01**	**0.01**	**0.02**	**0.01**
LSD (P=0.05)	**0.04**	**0.02**	**0.02**	**0.03**	**0.04**	**0.03**

Table.2 Effect of application of boron and potassium and their interaction on leaf B content (mg/kg) after 6 and 12 months of application

Levels of Boron	6 months (December)			12 months (June)		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
B_1	14.09	14.52	14.30	8.932	9.034	8.983
B_2	22.58	22.67	22.62	11.785	12.045	11.915
B_3	30.79	31.27	31.03	14.766	14.61	14.688
SE(m)±	0.16	0.19	0.15	0.25	0.25	0.22
LSD (P=0.05)	0.48	0.56	0.43	0.72	0.73	0.63
Levels of Potassium	**6 months (December)**			**12 months (June)**		
	2014-15	**2015-16**	**Pooled**	**2014-15**	**2015-16**	**Pooled**
K_1	23.22	23.63	23.42	12.25	12.34	12.29
K_2	23.24	23.78	23.51	12.39	12.37	12.38
K_3	21.00	21.05	21.02	10.84	10.98	10.91
SE(m)±	0.16	0.19	0.15	0.25	0.25	0.22
LSD (P=0.05)	0.48	0.56	0.43	0.72	0.73	0.63
Treatments	**6 months (December)**			**12 months (June)**		
	2014-15	**2015-16**	**Pooled**	**2014-15**	**2015-16**	**Pooled**
B_1K_1	14.22	14.73	14.47	9.60	9.48	9.54
B_1K_2	15.73	15.98	15.85	9.98	10.26	10.12
B_1K_3	12.31	12.85	12.58	7.22	7.36	7.29
B_2K_1	22.08	22.32	22.20	11.39	11.76	11.58
B_2K_2	25.00	24.05	24.52	13.05	13.31	13.18
B_2K_3	20.67	20.05	20.36	10.91	11.06	10.99
B_3K_1	33.42	34.29	33.86	16.18	15.87	16.02
B_3K_2	28.93	29.28	29.11	13.72	13.45	13.58
B_3K_3	30.02	30.24	30.13	14.40	14.52	14.46
SE(m)±	**0.28**	**0.33**	**0.25**	**0.43**	**0.43**	**0.37**
LSD (P=0.05)	**0.84**	**0.97**	**0.74**	**1.25**	**1.26**	**1.09**

Table.3 Effect of application of boron and potassium and their interaction on dry copra yield (kg per palm per year)				**Effect of application of boron and potassium and their interaction on dry copra yield (tons/ha/year)**		
Levels of Boron	**2014-15**	**2015-16**	**Pooled**	**2014-15**	**2015-16**	**Pooled**
B_1	7.97	8.33	8.15	1.44	1.52	1.48
B_2	11.73	12.38	12.06	2.09	2.30	2.19
B_3	4.32	4.56	4.44	0.76	0.75	0.75
SE(m)±	**0.29**	**0.25**	**0.26**	0.06	0.05	0.04
LSD (P=0.05)	**0.84**	**0.73**	**0.76**	0.18	0.14	0.13
Levels of Potassium	**2014-15**	**2015-16**	**Pooled**	**2014-15**	**2015-16**	**Pooled**
K_1	5.84	6.20	6.02	1.02	1.08	1.05
K_2	10.41	10.98	10.69	1.78	1.89	1.84
K_3	7.77	8.10	7.93	1.49	1.59	1.54
SE(m)±	**0.29**	**0.25**	**0.26**	**0.06**	**0.05**	**0.04**
LSD (P=0.05)	**0.84**	**0.73**	**0.76**	**0.18**	**0.14**	**0.13**
Treatments	**2014-15**	**2015-16**	**Pooled**	**2014-15**	**2015-16**	**Pooled**
B_1K_1	6.22	6.56	6.39	1.10	1.18	1.14
B_1K_2	10.82	11.31	11.06	1.88	1.97	1.92
B_1K_3	6.87	7.11	6.99	1.35	1.42	1.38
B_2K_1	7.58	8.13	7.85	1.31	1.44	1.37
B_2K_2	15.30	16.19	15.74	2.60	2.85	2.72
B_2K_3	12.30	12.84	12.57	2.37	2.60	2.49
B_3K_1	3.71	3.90	3.81	0.65	0.62	0.64
B_3K_2	5.10	5.45	5.28	0.87	0.87	0.87
B_3K_3	4.13	4.35	4.24	0.76	0.75	0.76
SE(m)±	**0.49**	**0.43**	**0.45**	**0.10**	**0.08**	**0.08**
LSD (P=0.05)	**1.45**	**1.27**	**1.31**	**0.31**	**0.24**	**0.22**

Fig.1 Effect of application of boron on leaf potassium content (%) after 6 and 12 months of application

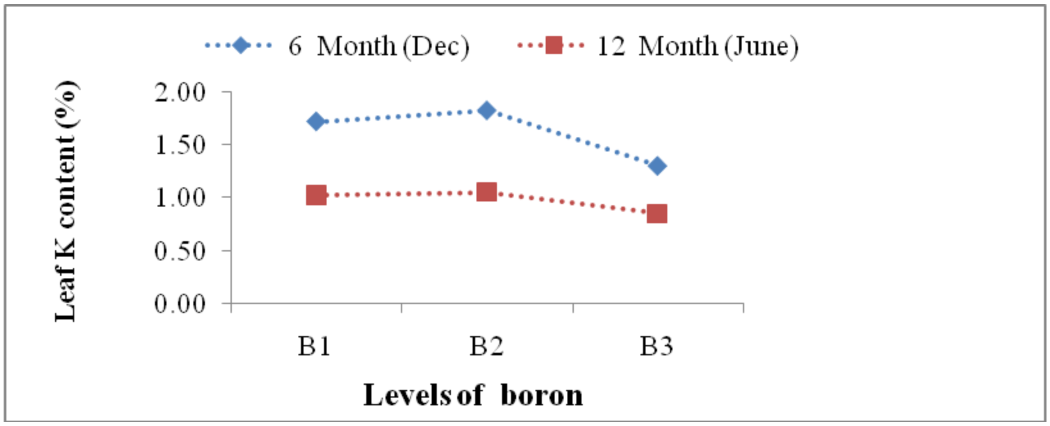


Fig.2 Effect of application of potassium on leaf potassium content (%) after 6 and 12 months of application

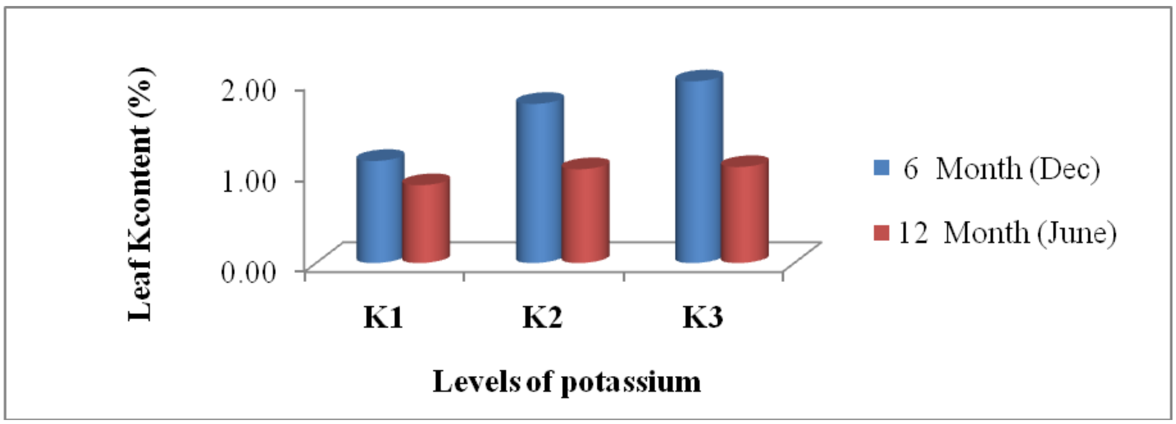


Fig.3 Interaction effect of boron and potassium on leaf potassium content (%) after 6 and 12 months of application

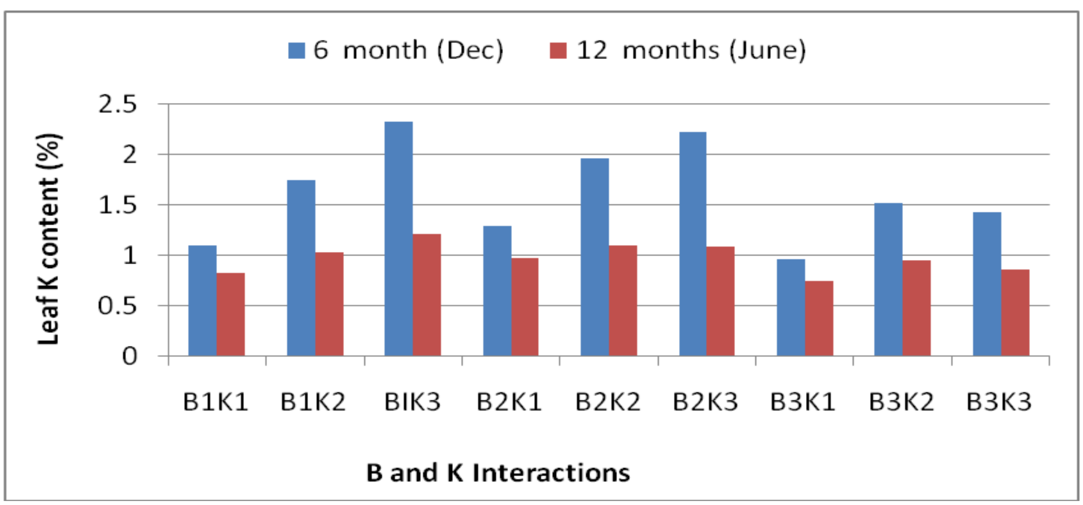


Fig.4 Effect of application of boron on leaf boron content (mg/kg) after 6 and 12 months of application

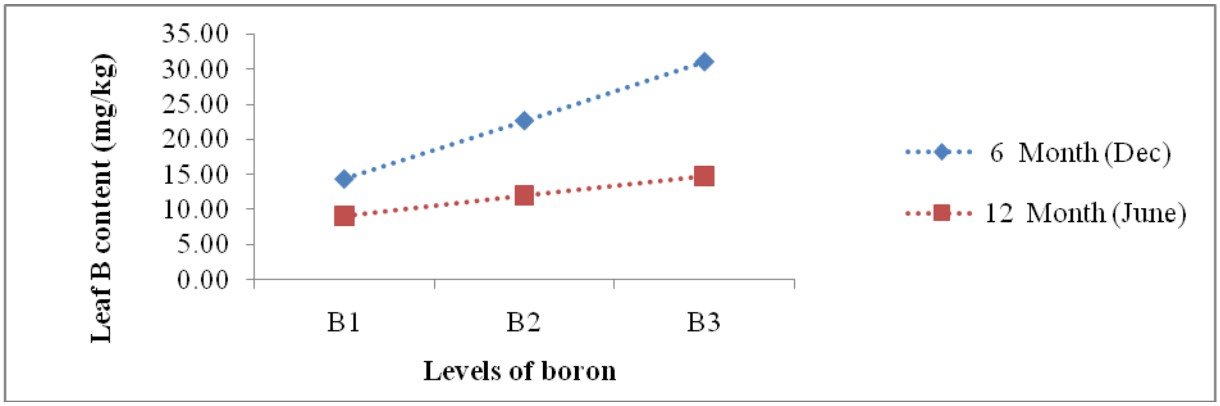


Fig.5 Effect of application of potassium on leaf boron content (mg/kg) after 6 and 12 months of application

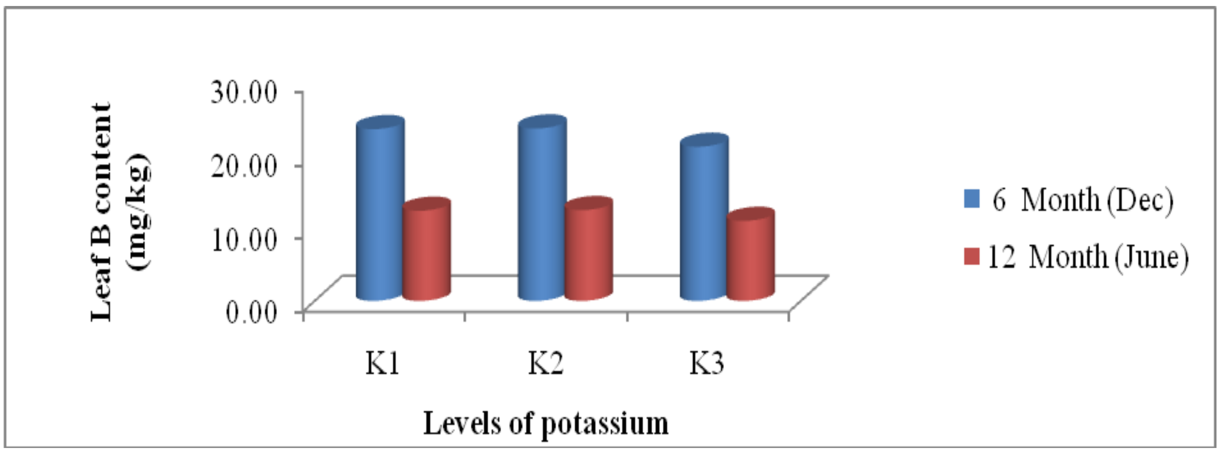


Fig.6 Interaction effect of boron and potassium on leaf boron content (mg/kg) after 6 and 12 months of application

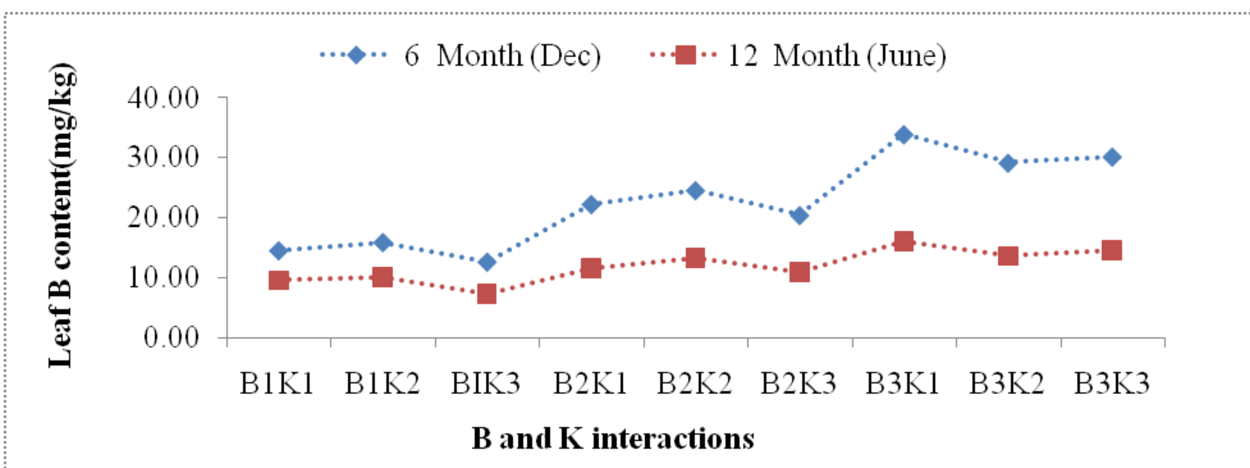


Fig.7 Effect of boron on dry copra yield

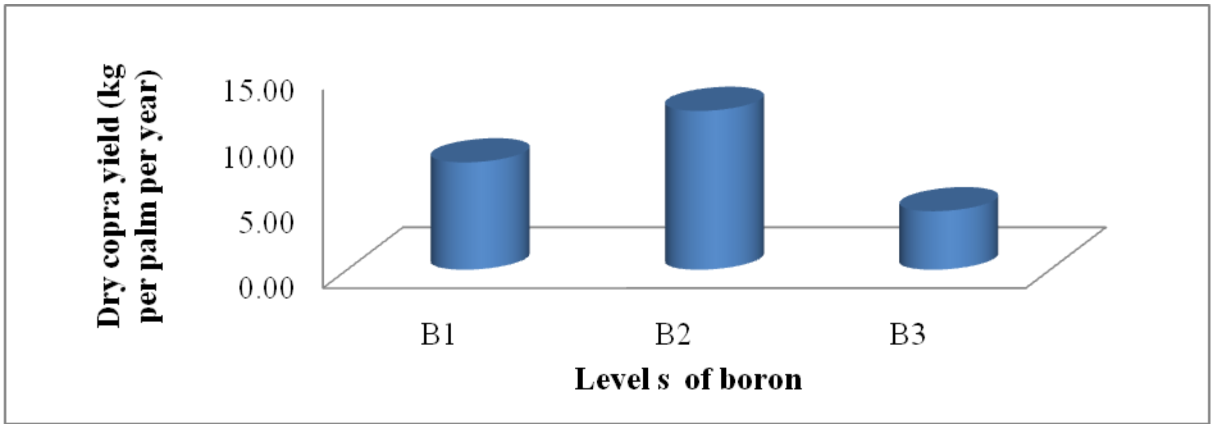


Fig.8 Effect of potassium on dry copra yield

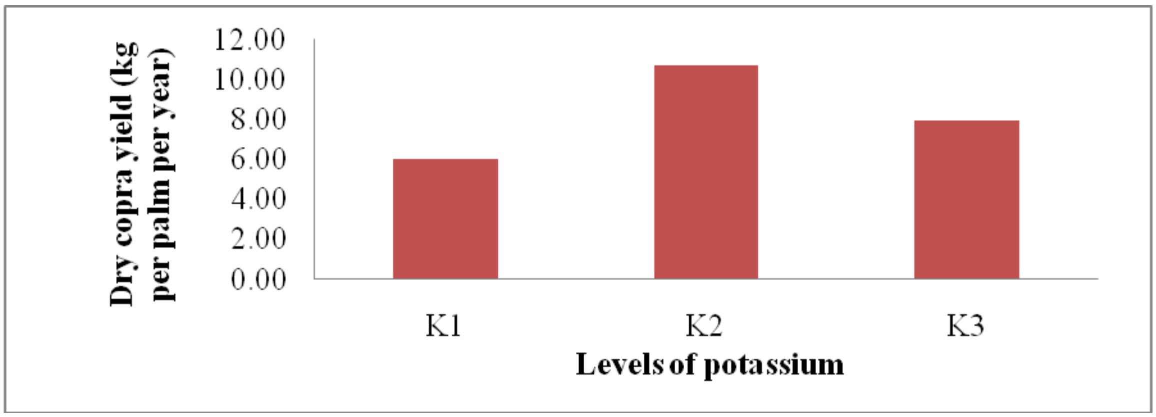
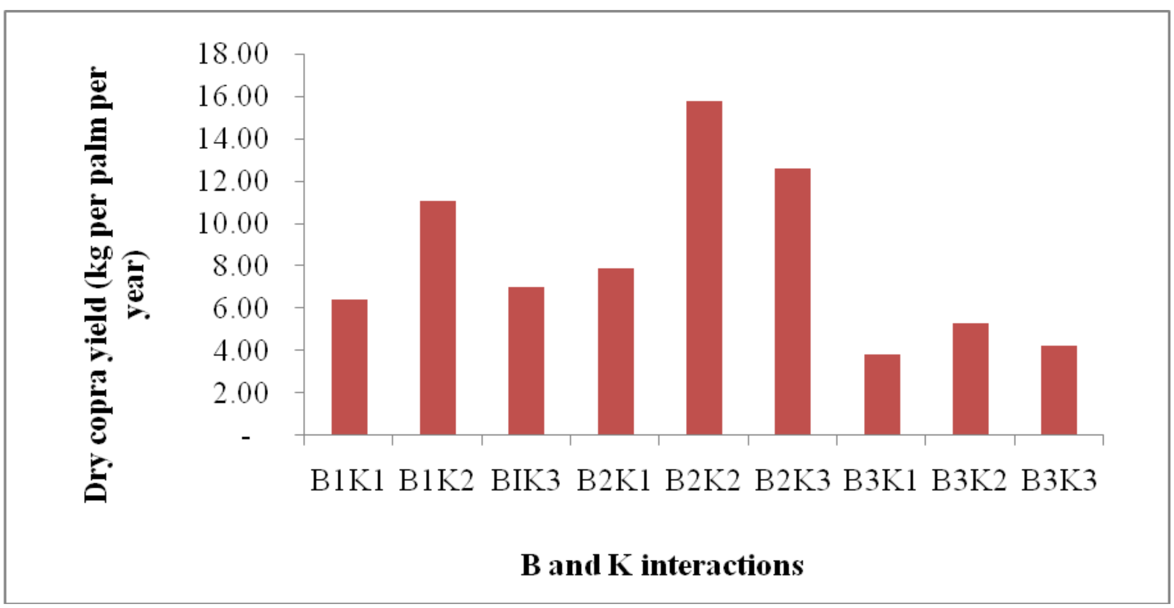


Fig.9 Interaction effect of boron and potassium on dry copra yield



This variation might be due to negative interaction between B and K at excess levels of available K due possibly to cation-anion imbalance as has been reported earlier by Samet *et al.,* (2015). The same trend was observed in 2014-15 and also in the case of pooled results for the two years. In any case, with increase in potassium supply, there was an increase in leaf boron content followed by significant increase at a certain boron level. This aspect is to be considered in coconut fertilisation so as to avoid boron toxicity in the coconut palms.

Interaction effects of boron and potassium on leaf B content

A perusal of data presented in Table 2 and Figure 6 showed that the leaf B content was the highest in B_3K_1 treatment followed by B_3K_3 and B_3K_2 treatments the leaf B content being 33.42, 30.02, and 28.93 mg/kg respectively and it was lowest in B_1K_3, followed by B_1K_1 and B_1K_2 treatments respective leaf boron content was 12.31, 14.22, and 15.73 mg/kg in 2014-15. The same trend was observed in the year 2015-16 and also for the mean of the two years. B and K interactions at the applied rates and combinations might have caused the differences in the leaf B content. This type of effect may be due to excess application of potassium caused to decrease in leaf B content. The results of the study suggest that as regards to leaf B content, there was synergistic interaction effect between potassium and boron in certain cases and antagonistic interaction in some cases. The synergistic combinations are to be adopted, and antagonistic combinations are to be avoided in applying fertilizers in coconut for maximising the nut yield of the plantation crop in *terai* region of West Bengal. The results of the study are in agreement with those of present findings confirmed the findings of Ranade-Malvi (2011). Considering the leaf (14^{th}) boron content ratings in coconut as suggested by Reuter and Robinson (1997), B_1K_1, B_1K_2 and B_1K_3 combination treatments were in low range, while, B_2K_1, B_2K_2 and B_2K_3 treatments were in adequate or sufficiency range at 6 month after soil application of B and K. At the same time period, the soils under the treatments viz. B_3K_1, B_3K_2 and B_3K_3 were in excess or high range of boron at 6 month after application of boron and potassium, suggesting that in such soils, boron reached toxic levels which cause toxicity effect, and boron should not be applied in coconut at such high rates. Further, it appears that the individual effects of boron and potassium and also their interaction effects pertaining to the leaf boron content had a decreasing trend from 6 to 12 months after soil application of boron and potassium. The continued decrease in leaf B content may because of the fact that during this period (6 to 12 months), boron might have been utilized in fruit setting, boosts up pollination, seed development, synthesis of cell wall, lignifications maintenances of cell wall structure integrity nitrogen metabolism, and protein biosynthesis. A similar result was also reported by Ahmad *et al.,* (2009).

Effect of B and K application and their interaction on copra yield

Effect of boron and potassium on copra yield

The result in relation to the effect of boron applications at different levels on dry copra yield kg per palm per year and tons per ha per year are presented in Table 3 and Figure 7 showed that in both the years, the dry copra yield was the highest at B_2 level of boron and with increase in boron level from B_1 to B_2, there was a substantial increase in dry copra yield (8.15 to 12.06 kg per palm per year and 1.48 to 2.19 tons per ha per year). Increase in dry copra yield was to the extent of about

32.4%. With further increase in boron to B_3 level, dry copra weight declined drastically (12.06 to 4.44 kg per palm per year and 2.19 to just 0.79 tons per ha per year). Presence of higher concentration of boron cause toxicity at B_3 level appears to be the reason for the reduction in the dry copra yield. The results of the present study suggest that application of boron in coconut at B_3 level therefore should never be applied.

Table 3 and Figure 8 present the results pertaining to the effect of potassium applications at different levels on dry copra yield. The results revealed that the dry copra yield increased from K_1 to K_2 level (6.02 to 10.69 kg per palm per year and 1.05 to 1.84 tons per ha per year). However, further increase in potassium supply from K_2 to K_3 level resulted in decreased dry copra yield (10.69 to 7.93 kg per palm per year and 1.84 to 1.54 tons per ha per year). Magat *et al.*, (1976) stated that decreased copra yield per palm with increasing levels of potassium application.

Interaction effects of boron and potassium on dry copra yield

The results with respect to boron-potassium interaction effects on dry copra yield are presented in Table 3 and Figure 9. With respect to dry copra yield among the treatments, B_2K_2 was performed and recorded highest (15.74 kg per palm per year and 2.72 tons per ha per year) followed by B_2K_3 (12.57 kg per palm per year 2.49 tons per ha per year) and B_1K_2 (11.06 kg per palm per year and 1.92 tons per ha per year). At an optimum concentration of boron-potassium interaction for increased dry copra weight was higher in B_2K_2 combination and beyond excess levels concentration of both nutrients showed negative result on copra yield which might be higher levels of boron with all levels of potassium impeded the availability of K from soil solution. The results suggest that for reaching the maximum dry copra yield, B_2K_2 level may be adopted in *terai* zone of west Bengal.

References

Ahmad, W., Niaz, A., Kanwal, S.R. and Rasheed, M.K. 2009. Role of boron in plant growth: A review. *Journal of Agricultural Research*, 47: 329-338.

Berger, K. C. and Truog, E. 1939. Boron determination in soils and plants. *Ind. Eng. Chem*, 11: 540-545.

Bray, R. H. and Kurtz, L.T. 1945. Determination of total, organic and available forms of phosphorus in soils. *Soil Science*, 59: 39-45.

De Silva, M.A.T. 1968. Recommended methods of fertilizer application for coconut palms. *Ceylon Coconut Planters*, 3:108-111.

Harishkumar, P., Nair, B.P., Rakhiappan, P., Nagabhushanan, S. and Moham, E. 1982. Variation in mineral composition of leaves of cashew (*Anacardium occidentale* L.) as effected by season, position and age. *Indian Cashew Journal*, 14 (1): 7-10.

Jackson, M. 1973. *Soil chemical analysis.* Prentice hall of India private limited, New Delhi.

Jackson, M. L. 1967. *Soil Chemical Analysis.* Prentice-Hall of India, New Delhi.

Magat, S.S., Cadigal, V. L. and Habana, J.A. 1976. Yield Improvement of Coconut in an Elevated Inland Area of Davao by Potassium Chloride Fertilization. *Philippine Journal of Crop Science*, 1: 60-63.

Manciot, R. Ollagnier, M. and Ochs, R. 1980. Mineral nutrition and fertilization of the coconut around world. *Oleagineux*, 35 (1): 23-27.

Marschner, H. 2012. In: *Mineral Nutrition of Higher Plants*. 3rd edition. Academic Press, London. pp: 178-189.

Mengel, K and Kirkby, E.A. 2001. Principles of Plant Nutrition. 5th edition. Dordrecth: *Kluwer Academic Publishers*, pp: 849.

Mengel, K. 1985. Dynamics and availability of major nutrients in soils. *Advances in Soil Science*, 2: 65-115.

Moura, J.Z., Prado, R.M., Benvindo, R.N. and Chaves, A.L. 2013. Applying boron to coconut palm plants: effects on the soil, on the plant nutritional status and on productivity boron to coconut palm trees. *Journal of Soil Science and Plant Nutrition*, 13 (1): 79-85.

Muhr, G.R., Datta, N.P., Sankarasubramoney, H., Leley, V.K. and Dunabha, R.L. 1965. Soil testing in India. Second edition, USAID-Mission to India, New Delhi.

Ranade-Malvi, U. 2011. Interaction of micronutrients with major nutrients with special reference to potassium. *Karnataka Journal of Agricultural science*, 24 (1): 106-109.

Reuter, D. J. and Robinson, J.B. 1997. *Plant Analysis*: An Interpretation manual (2nd edition). CSIRO Publishing

Samet, H., Cikili, Y. and Dursun, S. 2015. The role of potassium in alleviating boron toxicity and combined effects on nutrient concentrates in pepper (*Capsicum annuum* L.). *Bulgarian Journal of Agricultural Sciences*, 21 (1): 64-70.

Subbaiah, B.V. and Asija, G.L. 1956. A rapid procedure for the determination of available Nitrogen in soils. *Current Science*, 25: 256-260.

Venkitaswamy, R., Hameed Khan, H. and Palaniswami, C. 2011. Effect of graded levels of NPK on the reproductive characters and yield of hybrid coconut (COD X WCT). *Tropical Agriculture*, 86:13-20

Walkley, A. and Black, I.A. 1934. An examination of the different method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Journal of Soil Science*, 37: 93 - 101.

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