Assessment of The Performance of Different Forms of Boron on Yield of Cauliflower in West Bengal Condition

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ABSTRACT

*Cauliflower (*Brassica oleracea *var.* botrytis *L.) is an important cruciferous vegetable crop of India. Because of over mining of the plant food elements by the crops, most of the micronutrients including boron become in short-supply to the crops and some disorders appear resulting in low yields. The present study was undertaken with an objective to assess the performance of different forms of boron available in the market on yield of cauliflower through reducing Hollow Stem disorder under West Bengal Condition. The present study was carried out by Howrah KVK during* rabi *season for consecutive two years (2011-12 and 2012-13) as an On-Farm Trial at 5 farmers fields of an adopted village of Howrah district in West Bengal. In each trial, there were five treatments including one control i.e. farmer's practice. The study concludes that the hollow stem of cauliflower can effectively be managed by both T4 and T5 i.e. application of Farm Yard Manure @ 7.5 tonnes/ ha as basal and either application of Boric acid @ 0.3% or Liquid Boron @ 1.5 g/ l at 30 days after planting. The results of economic analysis reveal that highest net return as well as benefit cost ratio were also highest in T5 followed by T4 .*

Key word:*Efficacy, Boron, Cauliflower, Hollow Stem, Yield, Economics*

Cauliflower (*Brassica oleracea* var. *botrytis* L.) is an important cruciferous vegetable crop of India. During 2012-13, India produced 78,87,000thousand tonnes of cauliflower from an area of 4,02,000 thousand ha and the average productivity is 19.6 tonnes per ha (Anon., 2014). Though primarily the crop is a cool season crop, it is grown not only during the winter months, but also during post monsoon and autumn season as an early produce for its higher return in West Bengal condition especially due to expectation of good return during '*Durga Puja*'. Howrah district of West Bengal is traditionally a paddy district; however, in some pockets of the district, the cultivation of vegetables including cauliflower is increasing day by day. On the other hand, 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. Because of over mining of the plant food elements by the crops, most of the micronutrients become in short-supply to the crops and some disorders appear resulting in low yields (Joshi, 1997). And boron is not an exception. Availability of boron decreases due to intensive cultivation. Several physiological disorders have been reportedly produced by boron deficiency.In cauliflower, boron deficiency has been reported very frequently more particularly in soils of acidic in nature in all the cauliflower growing areas. At the time, external

symptoms of boron deficiency are not apparent. The first sign is the appearance of small water soaked areas in the centre of the curd. In later stages and in seriously affected plants, the stem becomes hollow with water socked tissue surrounding the walls of thecavity. In more advanced stages, pinkish or rusty brown area develops on the surface of the curd which is known as Red rot and cause low curd yield. The typical symptoms (water soaked) developed on the stem and card, which affects 62-65% curd. The affected cards are black spotted, bitter in taste, which incurred financial loss of the farmers.Application of boron significantly overcomes these problems and results in increased curd yield (Kotur and Kumar, 1980; Chatterjee, 1986). Through PRA, Howrah Krishi Vigyan Kendra (KVK) came to know that hollow stem is an increasing concern to the cauliflower growers of the district and farmers generally followed injudicious application of fungicides, insecticides, growth regulators because of their improper identification of the deficiency symptoms. However, there are different sources of boron viz. borax, sodium penta borate, fertilizer borate, boric acid, colemanite, solubor, single super phosphate available in the market (Bhardwaj, 2010) and a relatively newer form i.e. liquid boron (B-20%) is also available. Therefore, it has been necessary to study the performance of different forms of boron for enhancing the yield of cauliflower through reducing the incidence of hollow stem. Hence, the present investigation has been conducted.

METHODOLOGY

The present study was carried out by Howrah KVK under the guidance of Bidhan Chandra Krishi Viswavidyaya as well as ICAR (Zone-II) during *rabi* season for consecutive two years (2011-12 and 2012-13) as an On-Farm Trial at 5 farmers fields of an adopted village i.e. Jagatballavpur of Jagatballavpur block of Howrah district in West Bengal. The farmers, who grow cauliflower in every year and suffer due to hollow stem problem, have been chosen for the experiment. The area under each trial is 0.13 ha (i.e. 1 *bigha*). In each trial,there were five treatments viz. T1:Farmers' Practice (Control), T2: Application of Farm Yard Manure (0.4% Boron) @ 7.5 tonnes/ ha as basal, T3: Application of Farm Yard Manure @ 7.5 tonnes/ ha + Borax (2% Boron) @ 15 kg/ha as basal, T4: Application of Farm Yard Manure @ 7.5 tonnes/ ha as basal + Boric acid (20% Boron) @ 0.3% at 30 days after planting and T5: Application of Farm Yard Manure @ 7.5 tonnes/ ha as basal + Liquid Boron (20% Boron) @ 1.5 g/ l at 30 days after planting. In control treatment (T1)farmers' normal practice to control the deficiency symptom has been followed. Each farmer's field was treated as one replication.The seed of cauliflower var. Pusa Snow Ball were sown in the third week of September in both the years (2011 and 2012) and 22 days healthy seedlings were transplanted with a spacing of 45 cm x 45 cm in the second week of October. The field was fertilized with nitrogen, phosphorus and potassium @ 90-70-60 kg/ha in the form of urea, Single Super Phosphate (SSP) and Muriate of Potash (MOP), respectively. The mode of fertilizer application was full of FYM and SSP + half of nitrogen + 3/4 part of potassium was given as basal dose and rest amount of fertilizer was applied 30 days after planting.All the cultural operations were provided in time and plant protection measures were also adopted properly. The harvesting of the crop commenced from 2ndweek of December and continued till 1stweek of January during both the years of experimentation. The second year experiment has not been conducted in the same plot to avoid residual effect of nutrients. Accordingly, the observations on curd yield and other ancillary character i.e. curd weight were recorded.Yield characters were analysed statistically as per Gomez and Gomez (1984). The curd production per plot was converted to quintal per ha by simple arithmetic calculation. The analysis of Boron content in leaf has also been done. Afterwards, the economics of the experiment has been computed.

RESULTS AND DISCUSSION

Efficacy of different forms of boron: Effect of different forms of Boron differed significantly among themselves in respect of percent incidence of hollow stem as well as curd yield. From the records of an important ancillary character of yield i.e. curd weight, it has been observed that, highest mean curd weight has been recorded in treatments T5 (1415 g) and T4 (1385 g) and it was lowest in T1 i.e. 965 g (Table 1). In both the years, significantly highest curd yield has been recorded in case of T5 (517.5 q/ ha in 2011-12 and 543.8 q/ ha in 2012-13) and T4 (513.8 q/ ha in 2011-12 and 525.0 q/ ha in 2012-13) followed by T3, T2 and T1, however, T4 and T5 did not differ significantly among

Table 1. Performance ofdifferent forms of boron to reduce hollow stem of cauliflower

Treatments	Hollow stem incidence (%)			Curd weight (g)			Yield (q/ha)		
	I year	II year	Mean	I year	II year	Mean	I year	II year	Mean
T1 (Farmers' practices)	42.0	34.8	38.4	930	1000	965	348.8	375.0	361.9
T2: Application of FYM @ 7.5 tonnes/ ha as basal	26.0	18.6	22.3	1010	1050	1030	378.8	393.8	386.3
T3:Application of FYM @ 7.5 tonnes/ ha + Borax @ 15 kg/ha as basal	18.2	10.4	14.3	1260	1300	1280	472.5	487.5	480
T4:Application of FYM @ 7.5 tonnes/ ha as basal + Boric acid @ 0.3% at 30 days after planting	2.2	2.0	2.1	1370	1400	1385	513.8	525.0	519.4
T5:Application of FYM @ 7.5 tonnes/ ha as basal + Liquid Boron @ 1.5 g/lit at 30 days after planting	2.0	1.2	1.6	1380	1450	1415	517.5	543.8	530.65
CD(P=0.05)	0.324	0.635	-	-	-	-	7.329	8.067	-

Table 2. Boron content in leaf in different treatments

Treatments	Boron content (1st Year) (mg/ kg)		Boron content (2nd Year) (mg/ kg)	
	Initial	Final	Initial	Final
T1	0.52	0.5	0.44	0.42
T2	0.52	0.58	0.44	0.50
T3	0.52	0.61	0.44	0.53
T4	0.52	0.63	0.44	0.56
T5	0.52	0.64	0.44	0.58

Table 3. Economic analysis of different treatments to assess the performance of boron to reduce hollow stem of cauliflower

Treatments	Net Return (Rs / ha)			B:C Ratio		
	I year	II year	Mean	I year	II year	Mean
T1 (Farmers' practices)	39,940.00	64,250.00	52,095.00	1.62	1.96	1.79
T2: Application of FYM @ 7.5 tonnes/ ha as basal	63,380.00	86,020.00	74,700.00	1.92	2.20	2.06
T3:Application of FYM @ 7.5 tonnes/ ha + Borax @ 15 kg/ha as basal	97,800.00	1,29,750.00	1,13,775.00	2.35	2.73	2.54
T4:Application of FYM @ 7.5 tonnes/ ha as basal + Boric acid @ 0.3% at 30 days after planting	1,41,527.00	1,61,650.00	1,51,588.50	2.97	3.17	3.07
T5:Application of FYM @ 7.5 tonnes/ ha as basal + Liquid Boron @ 1.5 g/lit at 30 days after planting	1,47,237.50	1,82,505.00	1,64,871.30	3.03	3.41	3.22

themselves during 1st year of experimentation. The lowest yield has been obtained in farmers' practice in both the years (348.8 q/ ha in 2011-12 and 375 q/ ha in 2012-13). These types of result have been obtained due to difference in incidence of hollow stem in different treatments of the experiment. Table 1 stated that hollow stem incidence has been recorded lowest in T5 (1.6%) and T4 (2.1%). The lowest yield resulted treatment i.e. T1 showed highest incidence i.e. 42.0% in 2011-12 and 34.8% in 2012-13 and the mean incidence is 38.4%. From this study it can be concluded that the hollow stem of cauliflower can effectively be managed by both T4 and T5 i.e. application of Farm Yard Manure @ 7.5 tonnes/ ha as basal and either application of Boric acid @ 0.3% or Liquid Boron @ 1.5 g/ l at 30 days after planting. The efficacy of boron to enhance the curd weight as well as yield through decreasing hollow stem incidence has earlier been reported by Gupta and Cutcliffe (1973), Adhikary*et al.* (2004), Kumar *et al.* (2010). However, Singh *et al.* (2011) from their study, concluded that band placement of boron has been proved more effective to control hollow stem than foliar spray of boron though liquid boron and boric acid had not been included in their experimentation. From the

results of analysis of leaf during curd formation stage (Table 2), boron content of leaf has been found highest in T5followed by T4, T3, T2and T1, respectively in both the years (0.64 mg/ kg in 1st year and 0.58 mg/ kg in 2nd year for T5). It has been revealed from result that application of boron helps to increase boron content in leaf over control, which augments yield and quality of curd.

Economic analysis: For calculating gross return and cost of cultivation, the inputs and outputs prices of the produces prevailed during the investigationin both the years had been taken into consideration and afterwards from these two parameters net return as well as benefit cost ratio had been computed. Table 3 showed that, average highest net return has been achieved from T5 (Rs. 1,64,871.30/ ha) along with benefit cost ratio (3.03 in 2011-12 and 3.41in 2012-13 and mean is 3.22) followed by T4 (average net return Rs. 1,51,588.50/ ha and mean benefit cost ratio of 3.07). The benefit cost ratio of T1 has been recorded as 1.62 and 1.96, while the net return calculated is Rs. 39,940.00 and Rs. 64,250.00 during 2011-12 and 2012-13, respectively. These results clearly suggest that combined application of Farm Yard Manure @ 7.5 tonnes/ ha as basal and Liquid Boron @ 1.5 g/ l at 30 days after planting is more profitable than rest of the treatments.

CONCLUSION

From the study it can be concluded that hollow stem of cauliflower can be effectively managed by both T4 and T5 i.e. application of Farm Yard Manure @ 7.5 tonnes/ ha as basal and either application of Boric acid @ 0.3% or Liquid Boron @ 1.5 g/ l at 30 days after planting, however, application of Liquid Boron is more economic than rest of the treatments.

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