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EFFECT OF BORON AND MOLYBDENUM ON SEED PRODUCTION OF EARLY CAULIFLOWER (*BRASSICA OLERACEA* L. VAR. *BOTRYTIS*) CV PUSA KATKI

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SUMMARY

An experiment conducted on early cauliflower cv Pusa Katki with four levels each of boron (0, 5, 10 and 15 kg Borax/ha) and molybdenum (0,0.5, 1.0and 1.5kg Sodium molybdate / ha) revealed that 10kg Borax/ha recorded the highest plant height, leaves per plant, leaf size index, primary branches, length of siliqua, seed yield and least days to bolting. Application of 15 kg Borax/ha resulted in the lowest incidence of browning, maximum number of siliqua per plant, number of seeds per siliqua and total seed yield. Among the molybdenum levels, 1.0 kg Sodium molybdate/ ha recorded the maximum number of leaves, primary branches, siliqua per plant, length of siliqua and total seed yield while the highest plant height, leaf size index, number of seeds per siliqua, seed yield, least number of days to bolting and minimum incidence of whiptail were recorded with 1.5 kg Sodium molybdate / ha. Combined application of 10kg Borax with 1.0kg Sodium molybdate/ha gave highest cost: benefit ratio of 1 : 5.16.

सारांश

फूलगोभी के बीज उत्पादन में बोरान एवं मोलिबडेनम के प्रभाव के अध्ययन के लिये प्रयोग किया गया। परिणाम से स्पष्ट होता है कि बोरान 10 किग्रा. प्रति हेक्टेयर मिट्टी में मिलाकर नत्रजन, फास्फोरस एवं पोटाश की अनुमोदित मात्रा के साथ देने पर पौधे की लम्बाई, पत्तियों की संख्या, प्राथमिक शाखायें, सिलिका की लम्बाई तथा बीज उत्पादन में लाभकारी पाया गया। बोरान 15 किग्रा. प्रति हेक्टेयर देने पर सबसे अधिक सिलिका प्रति पौधा, बीज प्रति सिलिका तथा बीज उपज पाई गयी। सोडियम मोलिबडेड 1 किग्रा. प्रति हेक्टेयर देने पर पत्तियों की संख्या प्राथमिक शाखायें, सिलिका प्रति पौधा तथा बीज उपज सबसे अधिक पाया गया। बोरान 10 किग्रा. प्रति हेक्टेयर तथा सोडियम मोलिबडेड 1 किग्रा. प्रति हेक्टेयर साथ मिलाकर देने पर सबसे अधिक फायेदमंद पाया गया।

INTRODUCTION

Cauliflower (*Brassica oleracea* L. var. *botrytis*) is one of the important winter vegetables grown in Assam. Cauliflower in general is greatly affected by boron and molybdenum status in soil. Boron is leached down from soil due to high rainfall in Assam and low pH restricts the availability of molybdenum leading to deficiency disorders which ultimately reduces the seed yield. Therefore, the present study was undertaken to see the effect of boron and molybdenum on seed production of early cauliflower.

MATERIALS AND METHODS

The field experiment was conducted at Horticultural Experimental Farm, Assam Agricultural University, Jorhat during 2001-2002. The soil was sandy loam with pH 5.0. The experiment was laid out in randomized block design with three replications. The treatments comprised four levels of boron (0,5,10 and 15 kg borax/ha i.e. B_0, B_1, B_2 and B_3) and molybdenum (0, 0.5, 1.0 and 1.5 kg Sodium molybdate/ha i.e. M_0, M_1, M_2 and M_3). Borax and Sodium molybdate were applied at the time of final land preparation. Seedlings were transplanted at a spacing of 45 × 45cm in 2.7 × 2.7m plots. All the experimental plots received 160 kg nitrogen, 120 kg phosphorus and 100 kg potassium/ ha. Full dose of phosphorus , one fourth of nitrogen and half of potash were added as basal application and the second splits of nitrogen and potash were applied one month after transplanting, third application of nitrogen during curd formation and the fourth split of nitrogen was done at the time of bolting. Randomly selected plants were tagged for recording observations. Total seed yield was calculated on the basis of plot yield excluding border row plants.

Results and Discussion

The results revealed that the growth attributes were influenced by different levels of boron significantly (Table 1). The highest plant height (117.04cm), number of leaves (19.02), leaf size index (433.38cm^2), least days to bolting (110.38 days) were recorded in 10 kg Borax/ ha whereas 15 kg Borax/ha resulted in minimum browning incidence (0.91%). This

improvement in growth characters might had been due to increased cell division, enlargement of cells and auxin metabolism and increased rate of absorption of plant nutrients particularly of NPK brought about by boron. Browning of curd is attributed to disturbed phenol synthesis resulting from boron deficiency (Gupta, 1979). Enhanced boron supply might have increased B and Ca content in leaf tissue and both, in turn, imparted greater resistance to infection resulting in decreased browning of curds. This finding is in accordance with Dearbon and Releigh (1936), Bhattacharjee *et al*. (1984) and Prasad *et al*. (1988).

The highest level of molybdenum (1.5kg/ha) resulted in the maximum plant height (116.01cm), leaf index (407.45cm^2), least days to bolting (111.82 days) and whiptail incidence (1.14%). Maximum number of leaves (18.43) was recorded in 1.0 kg sodium molybdate/ha. This increase can be attributed to the fact that molybdenum is involved in nitrogen metabolism and an essential component of enzyme Nitrogen Reductase. Whiptail of cauliflower develops with high nitrate supply and low molybdenum (Agarwal and Hewitt, 1954) and therefore, adequate supply of molybdenum prevents it. Among interactions 10 kg Borax and 1.5 kg Sodium molybdate/ha recorded the maximum height of 120.00 cm and 10

Table 1 : Plant growth characters of early cauliflower

Treatment	Plant height (cm)	Number of leaves/ plant	Leaf size index (cm^2)	Days to bolting	Browning (%)	Whiptail (%)
B_0	108.86	17.05	332.99	115.35	17.12	7.40
B_1	114.68	17.53	387.77	111.77	8.79	7.16
B_2	117.04	19.02	433.38	110.38	2.75	4.84
B_3	117.00	17.74	427.34	111.85	0.91	4.61
CD at 5%	0.75	0.53	0.44	0.56	1.46	1.18
M_0	113.27	17.73	378.65	113.60	7.16	12.26
M_1	113.31	18.07	389.29	112.03	6.70	6.24
M_2	115.00	18.43	406.10	111.90	7.16	4.38
M_3	116.01	17.11	407.45	111.82	8.50	1.14
CD at 5%	0.75	0.53	0.44	0.56	NS	1.18

NS = Non-significant

Table 2. Plant growth characters of early cauliflowers as affected by interaction of boron and molybdenum

Treatment	Plant height(cm)	Number of leaves/ plant	Leaf size index (cm^2)	Days to bolting	Browning (%)	Whiptail (%)
Bo M_0	105.80	16.07	326.26	119.27	17.59	12.95
Bo M_1	107.20	17.20	330.14	115.33	15.73	9.26
Bo M_2	110.27	18.67	335.77	113.47	16.66	6.48
Bo M_3	112.16	16.27	339.79	113.33	18.51	0.91
B_1 M_0	114.00	17.07	345.72	112.80	6.48	13.88
B_1 M_1	114.13	18.27	356.18	111.80	9.26	7.40
B_1 M_2	115.51	16.67	420.71	111.27	8.33	5.55
B_1 M_3	115.06	18.13	428.47	111.20	11.11	1.82
B_2 M_0	116.25	19.53	416.35	111.07	2.76	12.03
B_2 M_1	115.90	19.53	440.35	109.06	1.82	4.61
B_2 M_2	116.01	20.07	441.43	110.20	2.73	1.82
B_2 M_3	120.00	16.93	435.41	110.67	3.67	0.91
B_3 M_0	117.01	18.27	426.28	111.27	1.82	10.18
B_3 M_1	115.99	17.27	430.49	111.40	0.00	3.67
B_3 M_2	118.20	18.33	426.49	112.67	0.91	3.67
B_3 M_3	116.80	17.10	426.12	112.07	0.91	0.91
CD at 5%						
B x M	1.50	1.05	0.89	1.13	NS	2.36

NS = Non-significant

kg Borax and 1.0 kg Sodium molybdate/ha recorded the maximum number of leaves (20.07) and leaf size index (441.43 cm^2). The least number of days to bolting (109.06) was recorded by 10 kg Borax and 0.5 kg Sodium molybdate/ha. No incidence of browning was recorded in 15 kg Borax and 0.5 kg Sodium molybdate/ha interaction level whereas, no Borax + 1.5 kg Sodium molybdate/ha, 10 kg Borax + 1.5 kg Sodium molybdate/ha and 15 kg Borax + 1.5 kg Sodium molybdate/ha recorded the lowest incidence of whiptail of 0.91 per cent (Table 2).

Data presented in Table 3 indicate that boron levels affected the seed yield attributing characters significantly. The maximum number of primary branches (6.15), length of siliqua (7.33 cm) and seed yield (11.06 g) were recorded with 10 kg Borax/ha. At the highest level of Borax (15 kg/ha), total seed yield (4.07 q/ha), siliqua per plant (433.35) and number of seeds per siliqua (16.62) were maximum. The increase in number of primary branches might had been due to reduction in the incidence of stem hollowness by boron which conforms to the findings of Ram and

Table 3: Seed yield and yield attributing characters of early cauliflower

Treatment	Number of primary branches	Siliqua/ plant	Length of siliqua (cm)	Seeds per siliqua	Seed yield (g/plant)	Total seed yield (q/ha)
B_0	3.24	260.30	5.03	7.28	7.33	2.16
B_1	4.79	364.80	6.92	11.76	9.47	3.13
B_2	6.15	429.26	7.33	13.20	11.06	3.93
B_3	6.04	433.35	7.24	16.62	10.55	4.07
CD at 5%	0.71	3.81	0.32	0.93	0.40	0.31
M_0	4.98	329.93	6.39	10.52	9.12	2.94
M_1	4.73	372.78	6.75	11.40	9.40	3.30
M_2	5.35	401.45	7.00	13.42	9.83	3.68
M_3	5.15	383.55	6.38	13.53	10.06	3.38
CD at 5%	NS	3.81	0.32	0.93	0.40	0.31

NS = Non-significant

Table 4. Seed yield and yield attributing characters of early cauliflower as affected by interaction of boron and molybdenum

Treatment	Number of primary branches	Siliqua / plant	Length of siliqua (cm)	Seeds per siliqua	Seed yield (g/plant)	Total seed yield (q/ha)
Bo M_0	3.50	168.67	4.83	8.03	5.60	1.65
Bo M_1	2.75	281.67	4.66	7.35	7.23	2.00
Bo M_2	3.25	283.13	5.28	7.49	7.49	2.40
Bo M_3	3.44	307.53	5.33	6.25	9.00	2.60
B_1 M_0	4.67	345.33	6.54	9.41	9.13	2.78
B_1 M_1	4.58	367.00	7.29	11.89	9.20	3.00
B_1 M_2	4.67	370.67	7.33	14.37	9.55	3.22
B_1 M_3	5.25	376.20	6.53	11.37	10.00	3.53
B_2 M_0	5.50	370.40	6.62	11.16	11.12	3.70
B_2 M_1	5.50	385.65	7.60	12.51	11.03	4.00
B_2 M_2	7.25	545.60	7.80	15.15	11.50	4.65
B_2 M_3	6.33	415.40	7.31	13.99	10.58	3.37
B_3 M_0	6.25	435.33	7.58	13.48	10.62	3.63
B_3 M_1	6.08	456.60	7.43	13.84	10.12	4.21
B_3 M_2	6.25	406.40	7.60	16.67	10.78	4.44
B_3 M_3	5.58	435.07	6.33	22.50	10.66	4.00
CD at 5%						
B x M	NS	7.62	0.64	1.86	0.80	0.62

NS = Non-significant

Table 5. Economics of cauliflower seed production

Treatment	Seed yield (q/ha)	Gross Return (Rs)	Total Cost of Cultivation (Rs)	Net Return (Rs)	Cost:Benefit Ratio
B_0M_0	1.65	1,23,750.00	53,218.40	70,531.60	1:1.33
B_0M_1	2.00	1,50,000.00	54,500. 17	95,499.83	1:1.75
B_0M_2	2.40	1,80,000.00	55,817.55	1,24,182.45	1:2.22
B_0M_3	2.60	1,95,000.00	57,099.33	1,37,900.67	1:2.42
B_1M_0	2.78	2,08,500.00	53,578.91	1,54,921.09	1:2.90
B_1M_1	3.00	2,25000.00	54,861.17	1,70,138.83	1:3.10
B_1M_2	3.22	2,41,500.00	56,178.55	1,85,321.45	1:3.29
B_1M_3	3.53	2,64,750.00	57,460.33	2,07,289.67	1:3.60
B_2M_0	3.70	2,77,500.00	53,940.38	2,23,559.62	1:4.14
B_2M_1	4.00	3,00,000.00	55,222.16	2,44,777.84	1:4.43
B_2M_2	4.65	3,48,750.00	56,539.54	2,92,210.46	1:5.16
B_2M_3	3.37	2,52,750.00	57,821.32	1,94,928.68	1:3.37
B_3M_0	3.63	2,72,250.00	54,296.42	2,17,953.58	1:4.01
B_3M_1	4.21	3,15,750.00	55,578.21	2,60,171.79	1:4.68
B_3M_2	4.44	3,33,000.00	56,895.60	2,76,104.40	1:4.85
B_3M_3	4.00	3,33,000.00	58,177.38	2,41,822.62	1:4.16

Sacham (1968-69). Improvement in other yield attributes and seed yield with higher levels of borax might be attributed to the particular function of boron in proper development of reproductive parts and stable pollen tube. Since boron helps to check the formation of hollowness and browning, quality curds were developed and ultimately bolting was proper for development of flower stalk, pod formation and seed setting (Venkataratnam, 1961).

Maximum number of primary branches (5.35), siliqua per plant (401.45), siliqua length (7.00 cm) and total seed yield (3.68 q/ha) were recorded with 1.0 kg sodium molybdate/ha (Table 3). Number of seeds per siliqua and seed yield increased linearly with increase in molybdenum levels. Maximum number of seeds (13.53) and seed yield (10.06 g) were registered in 1.5 kg sodium molybdate/ha. The improvement in yield attributes and seed yield might be due to enhanced protein synthesis by plants and positive effect on production of nitrates and nitrogen fixation (Ochse *et al*. 1970).

Combined application of 10 kg Borax/ha + 1.0 kg Sodium molybdate/ha recorded the maximum number of primary branches (7.25), siliqua/plant (545.60), length of siliqua (7.80 cm), seed yield (11.50 g/plant) and total seed yield (4.65 q/ha). The highest number of seeds per siliqua (22.50) was obtained with 15 kg Borax and 1.5 kg Sodium molybdate/ha (Table 4).

The highest cost : benefit ratio(1:5.16) was obtained in 10kg Borax + 1.0kg Sodium Molybdate/ha, followed by 15kg Borax + 1.0kg Sodium Molybdate/ ha which was obviously due to higher seed yield than other treatments, although the cultivation cost was maximum in these treatments. The lowest cost : benefit ratio of 1:1.33 was recorded in untreated control (Table 5).

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