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IMPACT OF BORON AND MOLYBDENUM ON YIELD AND YIELD ATTRIBUTES AND QUALITY OF VEGETABLE PEA (*Pisum sativum* L.) WITH AND WITHOUT PHOSPHORUS

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ABSTRACT

The experiment were conducted for two consecutive years under field condition during two rabi season 2002-2003 and 2003 -2004 at the vegetable research farm Kalyanpur C.S Azad university of Agriculture and Technology Kanpur, Uttar Pradesh. The soil was analysed for different physical and chemical characteristics and experiment was conducted under randomised block design (RBD) with 18 treatments and 3 replications. The resultant yield increases following P, B, and Mo fertilization. The important role is play by the these elements in the synthesis of chlorophyll for better yield of pea crop by using borax, molybdenum and phosphorus maturing obtained during courses of investigation many therefore, the attributes to increased number of pod per plant with more seed of bolder size, pod weight per plant in then contrast with control. This fact is further strengthened by visualizing the fact that plant, seed per pod, pod weight per plant and bolder seed size. Seed yield, straw yield (q/ha) also improved by the fertilization of borax, molybdenum and phosphorus. Protein content in mature pea seed significantly improved by the application of B, Mo, and P as well as alone and its combination. The maximum protein content was noted with borax (B10), molybdenum (Mo 0.5) and phosphorus (P60) over control, also crop yield and quality of pea increased significantly up to 60kg each of phosphorus.

Key words : *Pea, boron, phosphorus, growth character, protein content and yield components.*

Pea (*Pisum sativum* L.) is a very common nutritious vegetable crop grown in the cool season throughout the world. It ranks third in the world wide production amongst the grain legumes in India. It is grown as winter vegetable in the plains of north India and summer vegetable grown in the hills. Maximum cultivation pea is in Uttar Pradesh which account for about 60% areas under this crop followed by Bihar and Madhya. The interest in pea as soil building crop will increase day by day as a chemical fertilizer are becoming less available and more expansive (1).

Molybdenum is important for good foliage growth of higher plants. It is involved in the process of nitrogen fixation, nitrate reduction, in phosphate and nitrogen metabolism. Molybdenum is decrease in concentration of total reducing sugar and ascorbic acid concentration of many type plants under molybdenum deficiency have also been reported. Interaction among macro and micronutrients are also known to exist to affect normal plant growth. Phosphorus requirement of leguminous crop varies from crop to crop. It is therefore, considered worthwhile to study the differential response of vegetable pea, to different doses of boron and molybdenum, with and without phosphorus with the objective of obtaining normal growth and yield of the crops.

MATERIALS AND METHODS

The experiment were conducted for two consecutive years under field condition during two rabi season 2002 -2003 and 2003 -2004 at the vegetable research farm Kalyanpur C.S Azad university of Agriculture and Technology Kanpur ,Uttar Pradesh. The soil was analysed for different physical and chemical characteristics and experiment was conducted under randomised block design (RBD) with 18 treatments and 3 replications. The treatment details are given bellow.

The soil of experimental site was analysed for soil separate, ph available N, P_2O_5, K_2O, boron and molybdenum. The soil has ph 7.7 to 7.8, organic carbon (%) 0.86 and 0.69, available P (%) 0.11 and 0.10, available K (%) 0.25 and 0.26, available boron (ppm) 0.112 and 0.110, available molybdenum 0.004 and 0.005 (ppm). The mechanical analysis was by buoy oucos hydrometer method, pH was measured by the pH meter in 2:1 soil water suspension, organic

Level of boron	Level of molybdenum	Level of Phosphorus
B_o (0 kg borax /ha.)	M_0 (0 kg sodium molybdate/ha.)	P_0 (0 kg P_2O_5 /ha.)
B_5 (5 kg borax/ ha.)	$M_{0.5}$ (0.5 kg sodium molybdate/ha.)	P_0 (0 kg P_2O_5 /ha.)
B_{10} (10 kg borax/ ha)	$M_{1.0}$ (1.0 kg sodium molybdate/ha.)	P_{60} (60 kg P_2O_5 /ha.)

carbon by walkley and stacks available P by Olsen method K by margoun method, available boron and molybdenum were estimated by atomic absorption spectrophotometer in DTPA extract of soil. The seeds was analysed for protein by Kjeldhal-N method by ADAC method.

RESULTS AND DISCUSSION

Leaf area per plant and total chlorophyll content in fresh leaves presented Table-1, Leaf area per plant significantly improved by the application of boron and phosphorus at 90 DAS of plant growth and its was highest when borax (B_{10}) was added. In case of molybdenum, numerically maximum leaf area per plant was recorded in Mo 0.5 over control (M_o) but it was statically significant. The expansion in the leaf area was possibly due to efficient relative leaf expansion rate die to up to B10. In the case molybdenum, there was a progressive decline in the leaf area per plant at Mo 1.0 kg/ha. The increase leaf area might due to increase no of leafs per plant by both borax and phosphorus seems to provides better conditions for photosynthesis which resulted in bigger source. Total chlorophyll content in fresh pea leaves was estimated at flowering stage significantly improve by the application of both borax and phosphorus as well as in the interaction of B×P which at pod formation stage, the total chlorophyll content was significantly enhanced by application of borax, molybdenum and phosphorus as well as in all interaction. The trend in the next year same as in first year. (2) reported that chlorophyll a, chlorophyll b and carotenoid content in cowpea leave was increased at all the concentration of borax application. (3) indicated that the level of activity of enzymes of leaf tissue as well as chlorophyll content markedly influenced by

Table-1 : Leaf area per plants and Total chlorophyll content.

Treatment	Leaf area per plant at 90 DAS stage of plant growth (cm^2)				Total chlorophyll at flowering (mg/g tissue)				Total chlorophyll at flowering at pod formation			
	2001-2002		2002-2003		2001-2002		2002-2003		2001-2002		2002-2003	
	P_0	P_{60}	P_0	P_{60}	P_0	P_{60}	P_0	P_{60}	P_0	P_{60}	P_0	P60
Bo Mo 0	152.64	171.53	143.41	160.78	9.59	9.80	9.30	9.51	7.49	8.27	7.25	8.01
Bo Mo 0.5	153.68	172.43	144.35	161.34	9.62	9.85	9.33	9.56	7.43	8.41	7.19	8.14
Bo Mo 1.0	153.35	172.38	143.12	162.05	9.58	9.88	9.25	9.58	7.40	8.73	7.25	8.10
B5 Mo 0	158.26	176.39	148.78	165.82	9.62	10.05	9.33	9.75	7.58	8.20	7.34	7.93
B5 Mo 0.5	163.46	177.84	152.58	167.19	9.65	10.10	9.36	9.80	7.72	8.32	7.47	8.05
B5 Mo 1.0	162.90	176.47	152.23	165.90	9.67	10.03	9.38	9.73	7.67	8.25	7.43	7.99
B10 Mo 0	176.15	181.49	156.46	170.62	9.65	10.27	9.36	9.96	7.77	8.55	7.52	8.29
B10 Mo 0.5	168.48	183.74	158.37	172.73	9.70	10.23	9.41	9.92	8.00	8.65	7.74	8.37
B10 Mo 1.0	168.12	182.73	157.70	166.45	9.75	10.17	9.46	9.87	8.25	8.58	7.97	8.31
	SE(d)	CD at 5%	SE(d)	CD at 5%	SE(d)	CD at 5%	SE(d)	CD at 5%	SE(d)	CD at 5%	SE(d)	CD at 5%
B	2.27	4.62	1.93	3.91	0.014	0.03	0.02	0.04	0.009	0.019	0.012	0.025
MO	2.27	NS	1.93	NS	0.01	NS	0.02	NS	0.009	1.019	0.012	0.025
P	1.86	3.77	1.57	3.20	0.01	0.02	0.017	0.034	0.008	0.016	0.01	0.002
B×MO	3.94	NS	3.34	NS	0.02	NS	0.04	NS	0.016	0.033	0.021	0.043
B×P	3.21	NS	2.72	NS	0.02	0.04	0.03	0.06	0.014	0.028	0.017	0.035
MO×P	3.21	NS	2.72	NS	NS	0.03	0.03	NS	0.028	0.017	0.017	0.035

Table-2 : Yield ancillary characters in vegetable pea.

Treatment	Pod per plant				Pod weight per plant (g)				Seeds per pod				1000 Seed weight (g)				Harvest index (%)			
	2001-02 2002-03		2001-02 2002-03		2001-02 2002-03		2001-02 2002-03		2001-02 2002-03		2001-02 2002-03		2001- 02 2002-03		2001-02 2002-03		2001-02 2002-03		2001-02 2002-03	
	P0	P0	P60	P60	P0	P0	P60	P60	P0	P0	P60	P60	P0	P0	P60	P60	P0	P0	P60	P60
Bo Mo 0	16.77	14.76	39.87	37.92	18.00	16.94	24.39	22.95	5.90	5.61	8.32	7.90	154.68	148.05	170.67	163.31	42.02	39.92	49.91	47.41
Bo Mo 0.5	18.32	17.65	38.21	36.87	19.33	18.13	26.24	24.74	7.09	6.74	8.53	8.09	167.00	160.32	170.67	163.63	44.05	41.85	43.98	41.18
Bo Mo 1.0	23.12	21.54	39.65	36.98	18.61	17.48	23.03	21.67	7.05	6.70	8.61	8.18	173.00	165.76	181.00	174.44	49.31	46.84	50.83	48.29
B5 Mo 0	16.32	15.54	38.87	35.56	20.17	18.93	28.20	26.54	7.18	6.82	8.53	8.10	166.67	159.79	157.21	151.36	50.89	48.35	46.29	46.83
B5 Mo 0.5	21.32	19.54	41.54	38.76	20.61	19.20	30.53	28.73	7.49	7.12	8.81	8.37	164.33	157.33	170.00	136.20	41.95	39.85	46.32	44.00
B5 Mo 1.0	21.98	19.87	41.19	38.98	20.89	19.54	25.08	23.60	7.88	7.49	8.87	8.43	173.33	165.33	179.67	172.48	44.64	42.41	51.13	48.57
B10 Mo 0	28.43	26.64	42.92	39.17	22.27	20.87	28.24	26.57	8.05	7.65	8.98	8.53	156.67	149.97	134.67	159.28	50.82	48.28	49.98	47.48

molybdenum and phosphorus supply. Reduced activity of these enzymes undoubtedly would affect metabolism in general and perhaps may result in direct affect of chlorophyll metabolism.

Yield ancillary character presented in table-2 was favourably affected by phosphorus as well as borax and molybdenum fertilization in both the year. The resultant yield increases following P, B, and Mo fertilization. The important role is play by the these elements in the synthesis of chlorophyll for better yield of pea crop by using borax, molybdenum and phosphorus maturing obtained during courses of investigation many therefore, be attributes to increased number of pod per plant with more seed of bolder size, pod weight per plant in then contrast with control. This fact is further strengthened by visualizing the fact that plant, seed per pod, pod weight per plant and bolder seed size. Seed yield, straw yield (q/ha) also improved by the fertilization of borax, molybdenum and phosphorus in table-3. (4) reported that application of phosphorus increased no of pod per leaf of pea crop on Bonneville. Phosphorus fertilization (0, 40, 50,150 kg per ha) increased dry matter production, number of pod per plant, 1000 seed weight and seed yield in garden pea as reported by (5). (6) reported that application of Zn, B or Mo resulted in more vigorous vegetative growth, earlier flowering, and more formation of pod per plant and higher pod and seed yield then control.

Protein content in mature pea seed significantly improved by the application of B, Mo and P as well as alone and its combination. The maximum protein content was noted with borax (B10), molybdenum (Mo 0.5) and phosphorus (P60) over control, also crop yield and quality of pea increased significantly up to 60kg each of phosphorus and potassium (7) found that low percentage of boron in pea seeds a marked increased in concentration of sugar, nitrates, nitrogen, phenols and decreased in starch and proteins lowered quality of seeds. Thus the application of borax, molybdenum and phosphorus is likely to bi definite advantage to the cultivars is not only increasing the yield of pea but improving the quality of produce also. The investigation thus helps to fill the gap in understanding the yield of the crop as well as improving the quality of protein

Table-3 : Yield and quality characters in vegetable pea.

Treatment	Seed yield q/ha				Straw yield q/ha				Protein content in Seed (%)			
	2001-2002 TO 2002-2003		2001-2002 TO 2002-2003		2001-2002 TO 2002-2003		2001-2002 TO 2002-2003		2001-2002 TO 2002-2003		2001-2002 TO 2002-2003	
	P0	P0	P60	P60	P0	P0	P60	P60	P0	P0	P60	P60
Bo Mo 0	11.59	11.46	14.38	13.53	15.99	15.19	14.42	13.70	23.20	22.76	23.34	22.90
Bo Mo 0.5	15.88	14.71	20.21	19.02	20.17	19.16	25.74	24.45	23.16	22.72	23.58	23.14
Bo Mo 1.0	14.59	13.64	16.26	15.30	15.00	14.25	15.73	14.94	23.24	22.80	23.26	22.83
B5 Mo 0	13.14	12.23	15.01	14.12	12.68	12.05	15.44	14.67	22.95	22.52	23.76	23.31
B5 Mo 0.5	18.31	17.16	21.16	19.91	25.34	24.07	24.52	23.29	23.35	22.91	23.91	23.46
B5 Mo 1.0	15.80	14.71	16.90	15.90	19.59	18.61	16.15	15.34	23.14	22.70	23.66	23.21
B10 Mo 0	14.63	13.73	15.69	15.03	14.16	13.45	15.98	15.18	23.33	22.89	23.81	23.36
B10 Mo 0.5	18.58	16.47	22.34	21.02	21.17	20.11	23.31	22.14	23.42	22.68	23.66	23.21
B10 Mo 1.0	15.63	14.71	17.80	16.88	14.56	13.83	16.37	15.55	23.26	22.82	23.65	23.20
				CD at 5%				CD at 5%				CD at 5%
B				0.06				0.91				0.87
MO				0.06				0.91				0.87
P				0.04				0.75				0.71
B×MO				0.10				NS				1.50
B×P				0.08				NS				1.24
MO×P				0.08				NS				1.24
B×MO×P				0.14				NS				2.13

content. Formers are likely to carry larger yield per unit area as a result of investigation.

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