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Influence of phosphorus and lime on yield and physical parameters of Indian mustard (*Brassica juncea* L.) under wood apple (*Aegle marmelos* L.) based agri-horti system

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Abstract

An experiment was conducted at the Agricultural Research Farm of RGSC, Banaras Hindu University, Brakachha, Mirzapur during winter (*rabi*) season 2019. The experiment was laid out in a randomized block design with three replications and a set of 10 treatments on Indian Mustard involving with three levels each of phosphorus (30, 50, 70 kg P₂O₅ ha⁻¹) and lime (150, 300, 450 kg lime ha⁻¹) with one control (no P₂O₅ and no lime). Indian Mustard cv. "Giriraj" was sown on 16th November in 30 cm × 10 cm apart. Results stated that application of 70 kg P₂O₅ ha⁻¹ and 450 kg lime ha⁻¹ increased the seed yield up to 11.9% and 8.7% as compared to 30 kg P₂O₅ ha⁻¹ and 150 kg lime ha⁻¹ respectively. Similarly, 70 kg P₂O₅ and 450 kg lime ha⁻¹ showed increment in oil yield, biological yield, plant height, dry matter accumulation, and nutrient uptake percentage (NPK) over 30 kg P₂O₅ and 150 kg lime⁻¹. The results of yield and physical parameters obtained by the application of 70 kg P₂O₅ ha⁻¹ and 450 kg lime ha⁻¹ have shown significant increment as compared to 30 kg P₂O₅ and 150 kg lime⁻¹ respectively but was mostly at par when compared to 50 kg P₂O₅ ha⁻¹ and 300 kg lime ha⁻¹. It was also observed that the difference between 70 kg and 50 kg P₂O₅ for plant height and yield was found to be statistically at par and couldn't meet the critical difference.

Keywords: *Brassica juncea* (L.), phosphorus, lime, acid soil, NPK content

1. Introduction

Phosphorus (P) is an important element for the feasible production of *Brassica* species. Root system of mustard requires phosphorus for strong withholding of soil. Deficiency of the element causes dwarfism in plants with stunted roots. With severe deficiency, plants will be spindly, and if extremely deficient, mustard plants will have purple discoloration of the stems and leaves as well as be stunted. Phosphorus is also vital for energy translocation reactions and respiration process. Phosphorus availability from soil is not sufficient for growth in many soils because of its immobilization so it is important to apply phosphorus in the form of fertilizer. Fixation of phosphorus present in soil is increased with time of contact between soil particles and soluble phosphorus. Soil pH is another important factor which effects growth and development of crops. Low pH of soil tends to be acidic in nature which retards the growth of plants by reducing the uptake of plant nutrients. Acid soil accounts for 48 to 49 m ha arable land whereas 30% of cultivable land is acidic in nature. Excess weathering, uneven rainfall, humid climate are causes of acidic soil. Fertilizer management of such soils should be concerned. Soil acidity has indirect and direct effect on crops. Low pH shows direct effect due to increase in the concentration of H⁺, Al³⁺ which becomes toxic to soil microorganisms and plants. Indirect effects include effect of pH on organic matter decomposition and nutrient availability. Seed/pod filling of oilseed crop is hampered when grown under high acidic soil condition.

Application of lime in acidic soil can increase the pH of soil, availability of phosphorus, nitrogen mineralization, calcium exchangeable capacity and decrease acid saturation percentage. Valuing the application of phosphorus and lime on mustard in acid soil, present investigation was plotted at Vindhyhan region of Mirzapur, Uttar Pradesh.

2. Materials and Methods

The experiment was piloted in the region of Vindhyana, (25°10' latitude, 82°37' longitude and altitude of 427 meters above mean sea level) at Rajiv Gandhi South Campus, Barakachha, Banaras Hindu University, Mirzapur, Uttar Pradesh. Region comprises of sandy loam soil with acidic pH (5.9), low in organic carbon (0.28%) and nitrogen (179.60 kg ha⁻¹), moderate in available phosphorus (13.10 kg ha⁻¹) and potassium (183.25 kg ha⁻¹). The field experiment was evaluated during winter (Rabi) season of 2019-2020 under wood apple based agri-horti system, established in August 2006 at a spacing of 7 x 7 m² with mustard as an intercrop. The experiment was laid in factorial randomized block design with two factors comprising of lime and phosphorus having three levels of each. Levels of lime were taken as 150 kg, 300 kg, and 450 kg ha⁻¹ along with levels of phosphorus as 30 kg, 50 kg and 70 kg P₂O₅ ha⁻¹. Total numbers of treatment combinations were nine with one control (no P₂O₅ + no lime). Source of phosphorus and lime was DAP and slag lime respectively. Mustard seeds (Giriraj var.) @ 5 kg ha⁻¹ were sown at a spacing of 10 cm. Nitrogen was applied at basal dose (50% RDF) and at flowering stage at the rate of 90 kg ha⁻¹. MOP and bentonite Sulphur were applied as 50 kg and 30 kg ha⁻¹, respectively. Data of growth, yield and quality parameters were calculated by taking the mean of required parameter from five randomly selected plants from each plot. Analysis of data was carried statistically using F-test and the fluctuations between the mean values of treatments were estimated using critical difference (CD) values at 0.05% probability.

3. Results and Discussion

3.1 Effect of phosphorus levels

The yield attributing characters of crop viz. seeds per siliqua, length of siliqua and seed weight have shown increment with increasing levels of phosphorus (Table 1). It was observed that

maximum seed yield (1391 kg/ha) was obtained by the application of 70 kg followed by 50 kg and 30 kg P₂O₅ ha⁻¹. The increment in seed yield at 70 kg was 11.9% over 30 kg P₂O₅ ha⁻¹ (Table 1). Similar increment pattern was observed in oil yield. Application of 70 kg P₂O₅ ha⁻¹ have shown maximum oil yield (544 kg/ha) which contributed to 15.9% increment in oil yield over 30 kg P₂O₅ ha⁻¹ (Table 1). Further, data signified that application of 70 kg P₂O₅ ha⁻¹ have also shown higher plant height at all dates of observation as compared to 30 kg P₂O₅ ha⁻¹. The increment in height was up to 14.9 per cent from 30 kg to 70 kg P₂O₅ ha⁻¹ (Table 3). It was also observed that the difference between 70 kg and 50 kg P₂O₅ for plant height and yield was found to be statistically at par and couldn't meet the critical difference. Critical observation of data compiled of nitrogen, phosphorus and potassium content pointed out that it was increased with increasing levels from 30, 50, 70 kg P₂O₅ ha⁻¹ (Table 2). Similar pattern was observed for dry matter accumulation, biological yield, and harvest index (Table 3). Progressive increase in parameters with increasing phosphorus levels might be due its contribution in enhancing the growth activity and setting of pods as phosphorus is responsible for stimulation of flowering and seed formation. It promotes uniformity of crops and increase resistance to diseases. Similar findings were observed by Birle, 2011^[1]. Increase in seed weight might be due to the contribution of phosphorus in bold seed formation by increasing the size of the seed. It also helps in establishment of healthier stocks and root system. It is important for ripening of fruit and seeds. Phosphorus plays a major role in photosynthesis process, mobility of nutrients and transformation of genetic characteristics. It also influences utilization of nitrogen. Since, soil did not have appropriate phosphorus, application of P₂O₅ would have contributed towards overall improvement in growth of mustard. Relatable findings were also noticed by Mani *et al.*, (2006)^[14] and Nath *et al.*, (2018)^[15].

Table 1: Effect of phosphorus and lime on yield and yield attributes of Indian mustard under custard apple based agri-horti system.

Treatment	Yield Attributes				Yield	
	Number of siliqua plant ⁻¹	Length of siliqua (cm)	Seeds siliqua ⁻¹	Seed weight (g)	Seed yield (kg/ha)	Oil yield (kg/ha)
Control	197	3.50	8.67	3.97	1015	372
30	212	4.37	10.6	4.42	1243	469
50	224	5.27	12.7	4.74	1388	534
70	226	5.51	13.4	4.87	1391	544
Sem±	2.55	0.12	0.38	0.12	41.5	12.5
CD	5.35	0.25	0.79	0.25	87.2	26.1
Lime (kg/ha)						
150	209	4.63	4.63	4.40	1286	488
300	225	5.19	5.19	4.56	1338	515
450	227	5.32	5.32	4.76	1398	544
Sem±	2.55	0.12	0.38	0.12	41.5	12.5
CD	5.35	0.25	0.79	0.25	87.2	26.1

Table 2: Effect of phosphorus and lime levels on nutrient content of Indian mustard under custard apple based agri-horti system.

Treatment	Nitrogen content (%) in seed	Nitrogen content (%) in stover	Phosphorus content (%) in seed	Phosphorus content (%) in stover	Potassium content (%) in seed	Potassium content (%) in stover
Levels of phosphorus (kg P₂O₅ ha⁻¹)						
30	3.35	0.43	0.68	0.28	1	1.59
50	3.42	0.48	0.74	0.34	1.11	1.68
70	3.44	0.58	0.77	0.36	1.16	1.72
SEM±	0.02	0.02	0.02	0.01	0.03	0.02
CD (P=0.05)	0.05	0.04	0.05	0.02	0.06	0.04
Levels of lime (kg ha⁻¹)						

150	3.36	0.46	0.66	0.3	1.02	1.62
300	3.39	0.51	0.76	0.33	1.11	1.67
450	3.45	0.53	0.77	0.35	1.14	1.69
SEm±	0.02	0.02	0.02	0.01	0.03	0.02
CD (P=0.05)	0.05	0.04	0.05	0.02	0.06	0.04
Control (No phosphorus and No lime)	3.2	0.3	0.58	0.18	0.86	1.5
Rest of the treatment	3.39	0.46	0.71	0.31	1.05	1.63
SEm±	0.02	0.02	0.02	0.01	0.02	0.02
CD (P=0.05)	0.04	0.04	0.05	0.03	0.05	0.04
Open area plot [#]	3.43	0.52	0.77	0.4	1.3	1.68
Rest of the treatment	3.39	0.46	0.71	0.31	1.05	1.63
SEm±	0.02	0.02	0.02	0.01	0.02	0.02
CD (P=0.05)	0.04	0.04	0.05	0.03	0.05	0.04

3.2 Effect of lime levels

Significant variation was observed in yield attributes as well as height, nutrient uptake, dry matter uptake, biological yield, and harvest index. Results concluded that siliqua length, seeds per siliqua and seed weight was higher at 450 kg lime as compared to 300 kg and 150 kg lime ha⁻¹ (Table 1). Similar increment pattern was recorded for seed yield and oil yield (Table 1). Application of 450 kg lime increased the seed yield up to 8.7% and oil yield up to 11.2% over 150 kg lime ha⁻¹ (Table 1). The data also signified the application of 450 kg lime have shown higher plant height at all dates of observation as compared to 150 kg lime but was statistically at par with 300 kg lime ha⁻¹ (Table 3). However, the increment in height of plant was up to 7 per cent from 150 kg to 450 kg lime ha⁻¹. It was also observed that application of 450 kg lime ha⁻¹ has shown higher nitrogen, phosphorus and potassium content but was statistically at par with 300 kg lime ha⁻¹ (Table 2). Similar observation was found for dry matter accumulation, biological yield, and harvest index

(Table 3).

Liming increases pH dependent charge and precipitation of exchangeable aluminium, stimulates root growth at depth depending upon rate and time after application. Toxicity of Al at low pH <5.0 to 5.5 limits the organic matter breakdown through microbial activity, excess of aluminium also hinders division of cell at root tip and reduces lateral growth of root and resist replication of DNA by increasing the complexity of double helix DNA thus interferes with uptake, translocation, and transportation of essential elements like Na, K, P, Fe, Ca and Mo. The greatest benefit of lime application is reducing the toxicity of aluminium. Liming improves the conditions for growth of plants by increasing availability of phosphorus and basic cation, which results in better uptake of nutrition. Liming is widely accepted amelioration practice for efficient utilization of applied and native soil nutrients. Application of lime would have contributed towards neutralizing the acidic nature of soil which indirectly enhanced the growth and yield of crop.

Table 3: Effect of phosphorus and lime levels on plant height, dry matter accumulation, biological yield, and harvest index of mustard under custard apple based agri-horti system.

Treatment (Levels of phosphorus P2O5 kg/ha)	Plant Height				Dry Matter Accumulation				Biological Yield	Harvest Index (%)
	30 DAS	60 DAS	90 DAS	HARVEST	30 DAS	60 DAS	90 DAS	Harvest	Harvest	Harvest
30	12.62	139.67	145.67	147.11	0.96	19.3	56.68	57.5	6171	19.95
50	113.92	157.6	164.11	165.44	1.2	22.51	58.72	60.12	7065	19.73
70	14.57	159.11	168.67	169.89	1.24	22.71	59.54	61.33	7231	19.89
SEm±	0.39	2.61	2.44	1.28	0.03	0.36	0.52	0.66	114.71	0.35
CD (P=0.05)	0.81	5.48	5.12	2.7	0.06	0.75	1.09	1.39	241	NS
Levels of lime (kg ha ⁻¹)										
150	12.46	142.62	152.33	154.56	1.08	20.37	57.26	58.41	6482	19.94
300	13.93	155.27	160.56	161.67	1.16	21.86	58.38	59.92	6894	19.89
450	14.72	158.44	165.56	166.22	1.17	22.3	59.31	60.62	7091	19.73
SEm±	0.39	2.61	2.44	1.28	0.03	0.36	0.52	0.66	114.71	0.35
CD (P=0.05)	0.81	5.48	5.12	2.7	0.06	0.75	1.09	1.39	241	NS
Control (No phosphorus and No lime)	9.23	110.67	112.67	128.77	0.84	18.13	51.13	52.12	5276	22.15
Rest of the treatment	13.27	148.63	154.89	156.28	1.08	20.9	57.7	58.81	6618	19.84
SEm±	0.36	2.51	2.75	1.32	0.03	0.34	0.35	0.52	86.74	0.36
CD (P=0.05)	0.76	5.27	5.78	2.78	0.06	0.7	1.15	1.09	182.23	0.75
Open area plot [#]	14.5	159	164.33	170.67	1.24	22.17	58.13	60.66	7263	20.17
Rest of the treatment	13.27	148.63	154.89	156.28	1.08	20.9	57.7	58.81	6618	19.84
SEm±	0.36	2.51	2.75	1.32	0.03	0.34	0.35	0.52	86.74	0.36
CD (P=0.05)	0.76	5.27	5.78	2.78	0.06	0.7	1.15	1.09	182.23	0.75

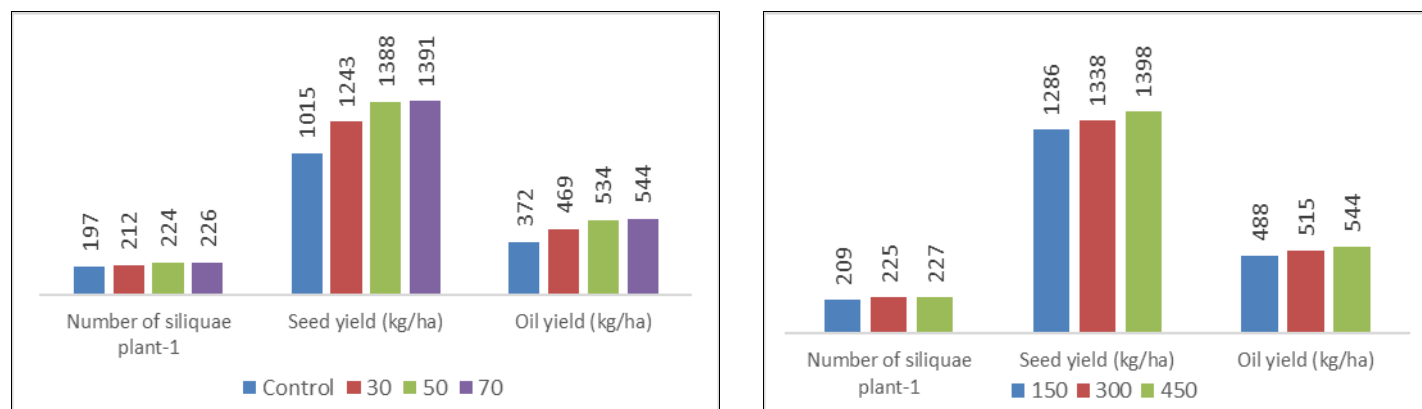


Fig 1: Effect of phosphorus and lime levels on number of siliqua(cm), seed yield, oil yield of mustard under custard apple based agri-horti system.

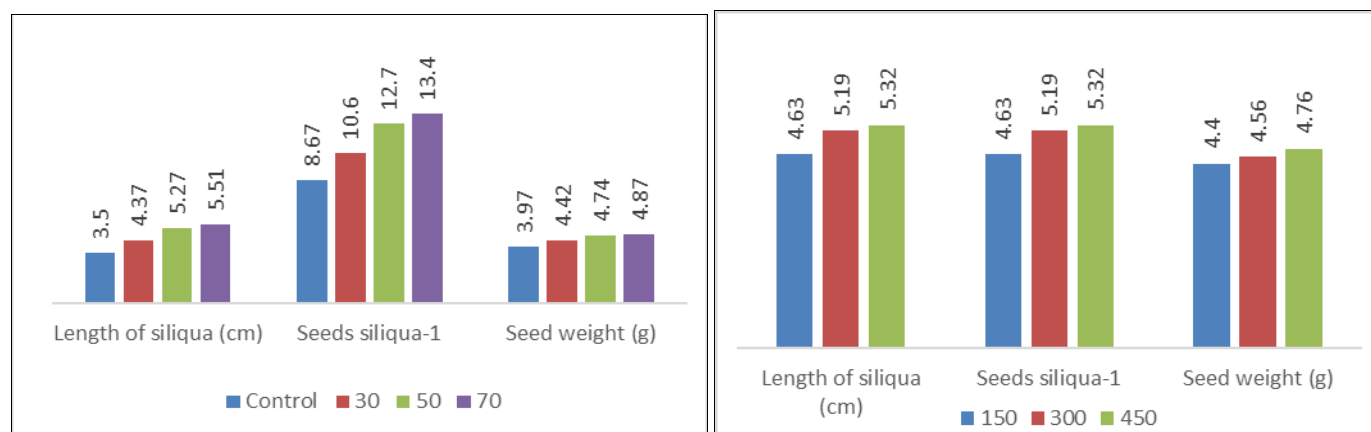


Fig 2: Effect of phosphorus and lime levels on length of siliqua(cm), seeds per siliqua, seed weight of mustard under custard apple based agri-horti system.

References

- Birle R. Effect of phosphorus and zinc on yield and chemical composition of mustard (*Brassica juncea* L.) grown on sodic soil environment [Internet]. 2011 [cited 2025 Oct 10]. Available from: <http://krishikosh.egranth.ac.in/handle/1/5810028594>
- Buni A. Effects of liming acidic soils on improving soil properties and yield of haricot bean. *J Environ Anal Toxicol*. 2014;5(1):1-4.
- Bray RH, Kurtz LT. Determination of total organic and available forms of phosphorus in soil. *Soil Sci*. 1945;59(1):39-45.
- Chimdi A, Gebrekidan H, Kibret K, Tadesse A. Effects of liming on acidity-related chemical properties of soils of different land use systems in Western Oromia, Ethiopia. *World J Agric Sci*. 2012;8(6):560-7.
- Gangwal TV, Patel MV, Jadav NJ. Effect of phosphorus, sulphur and phosphate solubilising bacteria on yield, nutrient uptake and soil fertility after harvest of mustard. *Indian J Fertil*. 2011;7(8):32-40.
- Giri PR, Khawale VS, Pawar WS, Sonawale AB. Effect of phosphorus and sulphur application on growth and yield of *Brassica juncea* L. *J Soils Crops*. 2005;15(2):448-51.
- Gomez KA, Gomez AA. Statistical procedures for agricultural research. 2nd ed. New York: John Wiley & Sons Inc; 1984. p. 183-204.
- Holford ICR, Schweitzer BE, Crocker GJ. Long-term effects of lime on soil-phosphorus solubility and sorption in eight acidic soils. *Aust J Soil Res*. 1994;32(4):795-803.
- Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India Pvt Ltd; 1973. p. 183-204.
- Singh SB, Thenua OVS. Effect of phosphorus and sulphur fertilization on yield and NPS uptake by mustard (*Brassica juncea* L.). *Prog Res Int J*. 2016;11(1):80-3.
- Singh SK, Pal L, Singh SP, Singh BR. Effect of phosphorus, sulphur and zinc on siliqua per plant, test weight and seed yield per plant of mustard (*Brassica juncea* L.). *J Rural Agric Res*. 2015;15(2):71-3.
- Singh V, Lodhi M, Verma NK. Effect of phosphorus and sulphur levels on growth and yield of mustard (*Brassica juncea* L.) variety 'Varuna'. *Agric Sci Dig*. 2008;28(1):59-60.
- Solanki R. Effect of phosphorus, sulphur and PSB on yield, quality and nutrient uptake of mustard (*Brassica juncea* L.) [Internet]. 2015 [cited 2025 Oct 10]. Available from: <http://krishikosh.egranth.ac.in/handle/1/581003541>
- Mani AK, Yadav DS, Singh R. Effect of phosphorus and sulfur on growth and yield of mustard (*Brassica juncea* L.). *J Oilseeds Res*. 2006;23(2):287-289.
- Nath S, Singh RK, Patel N. Influence of phosphorus and nitrogen on yield and nutrient uptake of mustard (*Brassica juncea* L.). *Int J Curr Microbiol Appl Sci*. 2018;7(3):1452-1458.