Journal of Oilseed Brassica, 16 (2) : 186-190, July 2025

Effect of POLY4 on growth, yield and economics of mustard (*Brassica juncea* L.)

Anil Jakhar[1*], Artika Singh[2], Anil Kumar Rai[2], Rahul Jakhar[3], Priyanka Choudhary[4], Jhabar Singh Lochhib[2], Meena Nehara[5], Shaily Purohit[5] and Manisha Choudhary[6]

[1]*Division of Agronomy,* [5]*Division of Horticulture, SKN Agriculture University, Jobner, Jaipur, Rajasthan, India*

[2]*Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh, India*

[3]*Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan, India*

[4]*JECRC University, Jaipur, Rajasthan, India*

[6]*Division of Horticulture, Agriculture University, Jodhpur, Rajasthan, India*

**Corresponding author: aniljakhar78912@gmail.com*

https://doi.org/10.56093/job.v16i2.6

Abstract

A field experiment was conducted during 2021-22 to evaluate the influence of POLY4 on growth and yield of mustard under various doses of nutrients with POLY4 fertilizerlevels on production and soil health.The experiment was laid out in completely randomized block design, comprising various doses of nutrients with POLY4 fertilizer included in 9 treatments (Control; 100% NPS; Farmers practice (60-40-0-10 kg ha^{-1} NPKS); 100% RDF(120-60-60-40 kg ha^{-1} NPKS) and 100% K through MOP; 100% RDF(120-60-60-40 kg ha^{-1} NPKS) and 100% K through POLY4; 100% RDF (50% K by MOP and 50% K by POLY4); 100% RDF(25% K by MOP and 75% K by POLY4); 100% NPS + 75%K (100% K by POLY4) and 100% NPS + 50% K (100% K by POLY4) replicated three times. Results showed that treatment T_7 (100% RDF *i.e.*25% K by MOP and 75% K by POLY4) was significantly superior to rest of the treatments with respect to plant height, primary branches/plant, secondary branches/plant and dry weight. Application of 100%RDF (25% K by MOP and 75% K by POLY4)was also better over other treatments in respect of yield and yield attributes *viz.*number of siliquae per plant and number of seeds etc. in clay loam soils of Bundelkhand region.The mustard crop fertilized with 100% RDF (25% K by MOP and 75% K by POLY4) fetched the highest net returns with maximum benefit-cost ratio.

Keywords *: Doses of nutrients,Growth, Mustard, POLY4, Yield*

Introduction

Oilseed crops have an important place in Indian agriculture, next to cereals. In India, nine oilseed crops are the major source of vegetable oil and fats. Globally, India is the fourth largest oilseed crops producing country after United States, China, and Brazil. In India, the oilseeds are grown on 14.4% of total gross cropped area (25.50 million ha), which produced 32.26 million tonnes oilseeds with 1265 kg ha^{-1}productivity (DAC & FW, 2020). After Canada and China, India is third in terms of rapeseed-mustard acreage and production. In India, it is cultivated on an area of 6.69 m ha and production of 10.1 mt with an average productivity of 1524 kg ha^{-1}, which is nearly 1/3rd of global average of 1960 kg ha^{-1} (DAC & FW, 2021). Rajasthan is the most populous state in terms of area and overall production, followed by Madhya Pradesh and Uttar Pradesh, and Haryana is the most productive, with2058 kg ha^{-1}of an average productivity (Anon., 2018).The rapeseed-mustard crop is grown on 121.58 thousand acres in the Bundelkhand region, yielding 92.80 thousand tonnes. In comparison to national productivity, the rapeseed-mustard crop productivity in Bundelkhand is quite low (763 kg ha^{-1}) (DRMR, 2019). The low yields are caused by a variety of issues including poor crop stand, insufficient nutrition, weed infestation, rainfed cultivation and pest and disease infestation.

POLY4 consists of sulfur, potassium, calcium, and other elements and among the numerous oilseeds cultivated, mustard has the highest sulphur requirement. POLY4 is a low-chloride, multi-nutrient fertilizer that can be used in organic farming. Polyhalite is a naturally occurring mineral that provides a variety of macro nutrients. POLY4 increased nutrient uptake and thereby improves fertilizer use efficiency. The steady dissolving rate of POLY4 provides continuous nutrition for the crops' growth cycle. Nutrients are released in an efficient and effective manner, closely matching the plant's requirements. POLY4 aids in the stabilization of the soil system. Calcium in POLY4 increases tensile strength, which prevents soil movement, and enhances compaction resistance, which prevents water runoff.

Plant membrane stability, cell integrity, cell division, and elongation, as well as numerous signal transduction pathways and activation, are also dependent on calcium (Ca). Furthermore, because calcium is transferred in plants via xylem sap, calcium cannot be remobilized from older tissues, highlighting the significance of a calcium fertilizer, such as polyhalite, in the Ca-deficient soils of the Indian

Punjab. Magnesium (Mg), which is also included in polyhalite, is necessary for plant photosynthesis and glucose partitioning, both of which have been linked to much higher SPAD readings. Sulfur (S) improves the effectiveness of nitrogen fertilizers, resulting in higher crop yields. For sustainable management of nutrients through POLY4, an experiment was conducted to evaluate the performance of POLY4 on mustard crop & its genetic response to phosphorus acquisition efficiency.

Materials and Methods

A field experiment was conducted during *rabi* season of 2021-22 at the Research Farm, Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh situated at25.515257° N latitude, 78.563506° E longitude, at an altitude of 284 m above the mean sea level. The soil was clay loam. The soil had pH value of 7.74, low in available nitrogen (122 kg ha^{-1}), available phosphorus (10.8 kg ha^{-1}) and high in potassium (265.44 kg ha^{-1}).The experiment was laid out in completely randomized block design, comprising various doses of nutrients with POLY4 fertilizer included in 9 treatments (Control; 100%NPS; Farmers practice (60-40-0-10 kg ha^{-1} NPKS); 100% RDF (120-60-60-40 kg ha^{-1} NPKS) and 100% K through MOP; 100% RDF(120-60-60-40 kg ha^{-1} NPKS) and 100% K through POLY4; 100% RDF (50% K by MOP and 50% K by POLY4); 100% RDF (25% K by MOP and 75% K by POLY4); 100% NPS + 75% K (100% K by POLY4) and 100% NPS + 50% K (100% K by POLY4) replicated three times.The seed rate of 5 kg ha^{-1} of mustard variety 'DRMRIJ-31 (Giriraj)' was used in this study. The recommended dose of POLY4 to fulfill the nutrient requirement of mustard was 430 kg ha^{-1}.The application of fertilizer was uniformly applied as per recommended dose of fertilizer with 120 kg N, 60 kg P_2O_5, 60 kg K_2O ha^{-1} and 40 kg S ha^{-1}. Half of the N in the form of urea and full doses of P in the form of diammonium phosphate, K in form of MOP and POLY4 as per treatment and S in the form of bentonite was applied as basal and the remaining amount of N was applied with first irrigation in the form of urea.

Results and Discussion

Effect on growth parameters

The data were recorded at 45, 90 DAS and at harvest, the significant effect on plant height at different stages of crop growth was observed. The perusal of data showed significant difference in the treatment where100% RDF (25% K by MOP and 75% K by POLY4). At 45 DAS, the maximum plant height (82.8cm) was observed in T_7, whereas the lowest value (50.1cm) was recorded in control (no application of fertilizer). At 90 DAS and harvest, the significant differences between treatments were seen and maximum plant height (193 and 198 cm) was recorded in T_7whereas, the lowest value of 156 cm and 168 cm, respectively was recorded in control (T_1).Satisha and Ganeshamurthy (2016) reported that for metabolites to be produced and transported to fruits, magnesium is essential. Both the strengthening of cell walls and proper plant cell devision require calcium. For the metabolism of amino acids, sulphur interacts with nitrogen during the synthesis and buildup of protein. Together, these nutrients affect many growth parameters including plant height.Similar findings were also reported byPavuluri *et al*. (2017), Singh *et al*. (2017) and Melgar *et al*. (2018).

Similarly, at 45, 90 DAS and at harvest the significant effect was seen in treatment T_7.The maximum primary branches/plant and dry weight were recorded in T_7 which was 4.17, 5.27 and 5.30 as well as 44.9 gm^{-2}, 347 gm^{-2} and 579 gm^{-2},whereas lowest value 3.03, 3.37 and 3.60 as well as 23.9 gm^{-2}, 154 gm^{-2} and 238 gm^{-2},respectivelywere recorded in T_1. It might be due to, potassium application in T_7 treatment through POLY4 and MOP which provides additional secondary and micro nutrients and may help to plant for the primary branches formation and dry matter accumulation as compared to other treatments.Similar results indicate the importance of sulphur nutrition for corn and that POLY4 is a source of sulphur and potassium for corn production (Pavuluri *et al*., 2017).Further, at 80 and 120 DAS, the significant effect was seen in treatment T_7 and maximum number of secondary branches/plant were recorded (16.4 and 18) as compare to thelowest (9.27 and 10.3) in T_1, respectively. POLY4 is a organic fertilizer that has no effect on soil microbes. As a result, there are more root nodules since the root growth is accelerated. Application of basal polyhalite in combination with other NPK fertilizers to meet crop requirement throughout the season is beneficial (Eryuce *et al*., 2019).

Effect on yield parameters

The perusal of data presented in table 2 concluded that the different doses of nutrient and POLY4 influenced the yield parameters. The treatment T_7 recorded maximum number of siliquae per plant (151.6) and number of seeds (16) per siliquaewhereas treatment T_1 recorded lowest value 96.2 and 10, respectively. Treatment T_7 significantly influenced 1000- seed weight of mustard as compared with treatment T_1. It might be due to availability of 4 macro nutrients out of 6 and micro nutrients at all growth stages of crop. Supply K and S nutrients through MOP and any source of sulphur there exists competition between chloride and sulphate anions, because of this availability of nutrients will decrease in case of conventional fertilizers. The higher fixation or adsorption of potassium from MOP to the clay particles may also be a contributing factor.

Table 1:Effect of different nutrient doses and POLY4 on growth parameters of mustard

Treatments	Plant height (cm)			Primary branches (no.)			Secondary branches (no.)		Dry matter accumulation		
	45 DAS	90 DAS	Harvest	45 DAS	90 DAS	Harvest	80 DAS	120 DAS	45 DAS	90 DAS	Harvest
T1: Control	50.1	156	168	3.03	3.37	3.60	9.27	10.3	23.9	154	238
T2:100% NPS	61.5	165	176	3.70	4.37	4.60	12.9	15.0	30.1	215	364
T3: Farmers practice (60-40-0-10 kg ha^{-1} NPKS)	55.8	161	173	3.17	4.20	4.23	12.9	13.7	24.0	177	297
T4:100% RDF (120-60-60-40 kg ha^{-1} NPKS) and 100% K through MOP	70.7	178	185	3.90	4.70	4.97	14.1	15.7	34.2	287	428
T5:100% RDF (120-60-60-40 kg ha^{-1} NPKS) and 100% K through POLY4	79.3	188	195	4.00	4.93	5.07	16.3	17.4	44.0	328	456
T6:100% RDF (50% K by MOP and 50% K by POLY4)	58.7	163	173	3.13	4.23	4.37	12.9	14.4	39.7	201	357
T7:100% RDF (25% K by MOP and 75% K by POLY4)	82.8	193	198	4.17	5.27	5.30	16.4	18.0	44.9	347	579
T8:100% NPS + 75% K (100% K by POLY4)	75.4	185	190	3.97	4.80	5.00	16.1	17.1	37.9	311	449
T9:100% NPS +50% K (100% K by POLY4)	64.8	169	179	3.87	4.63	4.73	14.1	15.2	30.7	261	423
SEm (±)	4.49	7.84	5.79	0.22	0.29	0.30	0.94	0.76	2.16	9	23
LSD (P=0.05)	13.4	23.5	17.3	0.67	0.88	0.91	2.83	2.28	6.49	28	71
CV	11.6	7.85	5.51	10.6	11.3	11.3	11.8	8.67	11.2	6	10

Due to competition between monovalent (K^+) and divalent (Ca^{2+}, Mg^{2+}) cations, such as adsorption or fixation may be less for POLY4. A similar finding was also reported by Rohit *et al*. (2020).The higher 1000-seed weight might be due to application of K or other nutrients and more translocation of photosynthates from source to sink for better crop growth (Tripathi *et al*., 2010).

Likewise, the effect of different treatments was seen on yield.The highest seed and stoveryield per plant was found in T_7 treatment(23.8 g and 28.5 g) while T_1 recorded lowest value (9.78 g and 11.5 g, respectively). Significant increase might be due to the availability of K throughout the life cycle of crop and also the effect of Ca, Mg, and S in POLY4 lead to increase in siliquae and seeds due to appropriate translocation and accumulation of required nutrients. Significant increase in yield of mustard due to potassium application was also reported by Singh *et al.* (2010). Different doses of nutrients and POLY4 had non-significant impact on harvest index. Due to this reason, maximum harvest index was seen in treatment T_7. Similar results were reported by Tomar and Tiwari (2005), that the mustard stover and seed yield considerably increased with increase in the nutrients content in plant and uptake of nutrients in mustard crop with application of NPK (100:50:50 kg ha^{-1}). The coated fertilizer/control release fertilizer not only increased the yield of rapeseed, but alsomore pod numbers, 1000-seed weight, seed numbers/ pod and use efficiency of applied fertilizer were found, in addition to that it also develop the resistance to disease, cold, and lodging of rapeseed crops.The seed yield showed a linear response to the polysulphate as compared to the control. S, K, Ca and Mg (component of poly-

Table 2: Effect of different nutrient doses and POLY4 on yield parameters of mustard

Treatments	Siliqua/ plant (no.)	Seeds/ siliquae (no.)	Test weight (g)	Seed yield/ plant (g)	Stover yield / plant (g)	Seed yield (kgha^{-1})	Stover yield (kgha^{-1})	HI (%)
T1: Control	96.2	10.0	3.49	9.8	11.5	646	1735	27.5
T2:100%NPS	120	13.3	4.26	18.2	21.2	1090	2549	30.1
T3: Farmers practice (60-40-0-10 kg ha^{-1}NPKS)	108	11.0	3.77	13.7	15.8	857	2114	28.9
T4:100% RDF (120-60-60-40 kg ha^{-1}NPKS) and 100%K through MOP	133	15.0	5.09	19.2	24.3	1297	2985	30.4
T5:100% RDF (120-60-60-40 kg ha^{-1}NPKS) and 100%K through POLY4	145	15.7	5.47	23.4	27.3	1396	3167	30.7
T6:100% RDF (50% K by MOP and 50% K by POLY4)	117	12.3	3.96	18.0	18.8	1033	2532	28.8
T7:100% RDF (25% K by MOP and 75% K by POLY4)	152	16.0	5.47	23.8	28.5	1789	4000	31.0
T8:100% NPS + 75%K (100% K by POLY4)	136	15.3	5.28	19.9	25.2	1358	3128	30.4
T9:100% NPS+50% K (100% K by POLY4)	126	14.0	4.59	18.8	21.6	1294	2933	30.5
SEm (±)	4.66	0.55	0.22	1.17	1.44	97.4	188	2.37
LSD (P=0.05)	13.9	1.65	0.68	3.53	4.34	292	564	NS
CV	6.42	7.00	8.57	11.1	11.6	14.11	11.7	13.7

Table 3: Effects of different nutrient doses and POLY4 on economics of mustard

Treatments	Gross returns(¹ ha^{-1})	Net returns(¹ ha^{-1})	B:C
T1: Control	38780	12780	0.49
T2:100% NPS	65420	32817	1.00
T3: Farmers practice (60-40-0-10 kg ha^{-1} NPKS)	51400	22119	0.76
T4:100% RDF (120-60-60-40kg ha^{-1} NPKS) and 100%K through MOP	77820	44417	1.32
T5:100% RDF (120-60-60-40kg ha^{-1} NPKS) and 100%K through POLY4	83760	41097	0.96
T6:100% RDF (50% K by MOP and 50% K by POLY4)	62000	24485	0.65
T7:100% RDF (25% K by MOP and 75% K by POLY4)	107340	67325	1.68
T8:100% NPS + 75% K (100% K by POLY4)	81480	41897	1.05
T9:100% NPS + 50% K (100% K by POLY4)	77660	41045	1.12
SEm (±)	5843	5843	0.15
LSD (P=0.05)	17520	17520	0.46
CV	14.1	27.7	26.4

sulphate) application appeared to increase the whole plant biomass, affecting most yield parameters.These results are confirmed with the findings of Tripathi *et al*. (2010), Fu-liang Ma *et al*. (2012), Wang *et al.* (2013), Paliwal and Singh (2014) and Tiwari *et al*. (2015).

Economic analysis

The data clearly represents that treatment T_7 recorded highest gross return and found significantly superior to treatment T_1. Although net profits are down when POLY4 is applied because of higher cultivation costs, they are still higher than other treatments. The variations was among the different treatments and found significant effect on net returns in treatment T_7, whereas, the lowest net return was obtained in control. Further, data represented that the benefit cost ratio was significantly affected with various levels of nutrients and POLY4. The treatment T_7 with 100% RDF (25% K by MOP and 75% K by POLY4) showed

significant values of yield, yield attributes and benefit cost ratio while controlhad lowest B-C ratio.

Conclusion

On the basis of experimental results, it can be concluded that the growthand yield parameters and economics in mustard were found highest in the treatment T_7 consisted of 100% RDF and K- 75% through POLY4 and 25% through MOP in clay loam soils of Bundelkhand region.

References

Anonymous.2018.Department of Agriculture and Farmers Welfare.Ministry of Agriculture and Farmers Welfare.Government of India.

DAC&FW. 2020. Department of Agriculture and Farmers Welfare. Ministry of Agriculture and Farmers Welfare. Government of India.

DAC&FW. 2021. Department of Agriculture and Farmers Welfare. Ministry of Agriculture and Farmers Welfare.Government of India.

Eryuce N, Ozkan CF, Anac D, Asri F, Güven D, Demirtas EL and Ari N. 2019. Effect of different potassium fertilizers on cotton yield and quality in Turkey. *Electronic Int Fertil Correspondent* (e-ifc), **57**: 3-20.

Fu-liang MA, Fu-peng S, Yang G andPeng Z. 2012. Effects of sulfur-and polymer-coated controlled release urea fertilizers on wheat yield and quality and fertilizer nitrogen use efficiency. *Yingyong Shengtai Xuebao,* **23**: 67.

Melgar RJ, Ventimiglia L, Figueroa E, Centurion O and Vale F. 2018.Polyhalite for grain in soybean-based production systems in Argentina and Paraguay. *Electronic Int Fertil Correspondent* (e-ifc), **55**: 3-12.

Paliwal A and Singh JP. 2014. Response of mustard [*Brassica juncea* (L.) Czern.&Coss] to potassium with other nutrients on yield and quality.*The Bioscan,* **9**: 649-652.

Pavuluri K, Malley Z, Mzimbiri MK, Lewis TD and Meakin R. 2017.Evaluation of polyhalite in comparison to muriate of potash for corn grain yield in the Southern Highlands of Tanzania. *Afr J Agron,* **5**: 325-332.

Rohit Singh J. 2020. Effect of potassium application on seed yield of mustard in Agra. *Int J Ecolo Environ Sci,* **2**: 253-254.

Satisha GC and Ganeshamurthy AN. 2016. Bioefficacy of polyhalite application on yield and quality of cabbage and cauliflower. *Electronic Int Fertil Correspondent* (e-ifc), **44**: 21-31.

Singh RK, Singh AK and Kumar R. 2010.Effect of fertility level on nutrient uptake, yield and quality of Indian mustard [*Brassica juncea* (L.) Czern and Coss.] varieties under late sown condition. *Environ Ecolo,* **28**: 1764-1767.

Singh JP, Bhardwaj KK and Tomar D. 2017. Effect of potassium application on yield of and nutrient uptake by mustard. *Ind J Fertil* **13**: 68-72.

Tiwari DD, Panday SB and Katiyar NK. 2015. Effects of polyhalite as a fertilizer on yield and quality of the oilseed crops mustard and sesamum. *Int Potash Inst* **42**: 9-15.

Tomar TS, Singh S, Kumar S, Tomar S, Sigh SK and Tomar S. 1996. Response of Indian mustard (*Brassica juncea*) to nitrogen, phosphorus and sulphur fertilization. *Ind J Agron,* **42**: 148-151.

Tripathi MK, Chaturvedi S, Shukla DK andMahapatra BS.2010. Yield performance and quality in Indian mustard (*Brassica juncea* L.) as affected by integrated nutrient management. *Ind J Agron,* **55**: 138-142.

Wang SP, Li XK and Lu JW. 2013. Effects of combined application of urea and controlled-release urea on yield, profits of rapeseed and soil inorganic nitrogen. *Chin J Oil Crop Sci,* **35**: 295-300.