Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.8818

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2021) *9*(5), 184-189

Indian Journal of Pure & Applied Biosciences

Peer-Reviewed, Refereed, Open Access Journal

Research Article

Effect of Phosphorus and KSB Levels on Growth and Yield of Rice (*Oryza sativa* L.)

Pandey Vikas[1]* and T. Singh[2]

Department of Agronomy, AKS University, Satna (M.P.)

*Corresponding Author E-mail: vikas.pandey9877@gmail.com

Received: 8.09.2021 | Revised: 12.10.2021 | Accepted: 19.10.2021

ABSTRACT

A experiment was conducted at Instructional Farm, Department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) during winter season of 2020-21. The experiment consisted of 12 treatment combinations including four levels of phosphorus and treatments were P0- 0 kg/ha, P1- 70 kg/ ha, P2- 80 kg/ ha and P3- 90 kg/ha, where as KSB levels were tested are K1- 0 ml/ha, K2- 300 ml/ha and K3- 400 ml/ha. During the course of the study, it was found that phosphorus and KSB application significantly affected plant height, number of leaves per plant, number of tillers per hill, length of panicle, number of grains per panicle, number of filled grain per panicle, test weight, grain and stover yield of rice. Higher plant height (87.27 cm), number of leaves per plant (69.80), number of tillers per hill (21.33) at maximum crop growth stage of 90 DAT were recorded in plots treated with phosphorus @ 90 kg/ha in combination with application of KSB @ 400 ml/ha. Similarly, resulted in highest length of panicle (26.92 cm), number of grains per panicle (183.07), number of filled grain per panicle (170.67), test weight (25.86 g), grain yield/ha (52.47 q/ha) and stover yield/ha (90.40 q/ha) recorded under same treatment combination of phosphorus @ 90 kg/ha with application of KSB @ 400 ml/ha. It was concluded from the results that application of phosphorus @ 90 kg/ha with application of KSB @ 400 ml/ha improved yield and yield components of rice.

Keywords: *Phosphorus, Grains, Panicle, Test weight, Stover yield.*

INTRODUCTION

Rice is the second most important crop after rice. Rice has a largest growing area and it covers nearly 9 per cent of earth's arable land. Rice provides 35% of total calorie intake by the Asian people. Asian countries produce 89 per cent of world's rice, with China and India alone accounting for 55 per cent of production "Rice is Life" for millions of people and staple food for more than half of the world's population.

Cite this article: Vikas, P., & Singh, T. (2021). Effect of Phosphorus and KSB Levels on Growth and Yield of Rice (*Oryza sativa* L.), *Ind. J. Pure App. Biosci.* *9*(5), 184-189. doi: http://dx.doi.org/10.18782/2582-2845.8818

Worldwide, rice is grown on 161 million hectares, with the production of about 713.8 million tones with an average productivity of 4.44 tones/ha (IRRI, 2014). In India, Rice is cultivated on an area of 44 million ha, producing around 108.86 million tones (Annual Report, 2016-17). In M.P. rice is grown in the area of about 15.59 lakh ha with production of 14.62 lakh tons and productivity 989 kg/ha. (GOI, 2017).

Fertilizer is an indispensable, and one of the costly inputs. Phosphorus is an essential macro nutrient among the fertilizer elements, after nitrogen and if a plant suffers from phosphorus deficiency, it can't produce good yield. Further, only when required amount of phosphorus is supplied, there will be an optimum response to added nitrogen. It is one of the major components for ATP and many genetic materials that are required for seed production. Phosphorus stimulates early root growth and development, encourages more active tillering and promotes early flowering, maturity and good grain development. Phosphorous (P) is an essential plant nutrient important for root development, tillering, early flowering, and ripening. It is mobile within the plant, but not in the soil.

Phosphorus and Potassium are the essential macronutrients for plant growth and development, and hence they are commonly added as fertilizer to optimize growth and yield. Deficiency of potassium causes necrosis and interveinal chlorosis and also reduce the rate of photosynthesis where as in phosphorus deficiency leaves may develop purple pigment, stunted plant growth and delay in plant development. It activates enzymes, maintains cell turgor, enhances photosynthesis, reduces respiration, helps in transport of sugars and starches, helps in nitrogen uptake and is essential for protein synthesis. In addition to plant metabolism, potassium improves crop quality because it helps in grain filling and kernel weight, strengthens straw, increases disease resistance and helps the plant better to withstand stress.

MATERIALS AND METHODS

The experiment was carried out at Instructional Farm, Faculty of Agriculture, AKS University, Satna (M.P.) during Rabi season 2020-21. The experiment was conducted in randomize complete block design having Factorial concept with three replications. Different rates of phosphorus and KSB will be allocated to the plots as per treatments. Net plots size was 4.0 x 3.0 m^2. Seed rate used as 30 kg/ha for transplanting with 20.0 cm row to row distance. The treatments were P_0- 0 kg/ha, P_1- 70 kg/ ha, P_2- 80 kg/ ha and P_3- 90 kg/ha, while KSB levels were tested are K_1- 0 ml/ha, K_2- 300 ml/ha and K_3- 400 ml/ha. The gross and net plot size was 5 m x 3.5 m and 4 m x 3 m, respectively. The fertilizers grades were applied as per treatments. Whole dose of P and K was applied as basal dose at the time of sowing. Full recommended dose of phosphorus and potassium at the rate of 80 kg P_2O_5 /ha and 60 Kg K_2O /ha, respectively and half dose of nitrogen @ 120 kg/ha was uniformly applied to each plot (except control plots) as basal dose before transplanting. Remaining half dose of nitrogen was applied as basal dose at the time of sowing and remaining half dose of nitrogen was applied in two equal splits at 30 and 60 DAT i.e., at tillering and panicle initiation stage. All the other agronomic practices were applied uniformly to all the treatments. The experiment will be consisting of the following factors along with their respective levels.

RESULTS AND DISCUSSION

Data regarding plant height, number of leaves per plant and number of tillers per hill are reported in (Table 1). Statistical analysis of the data revealed that maximum plant height (86.53 cm), number of leaves per plant (66.76) and number of tillers per hill (20.80) at maximum crop growth stage of 90 DAT were recorded in plots treated with the application of phosphorus @ 90 kg/ha while, lowest values were observed in plot that received no nitrogen. However, application of KSB @ 400 ml/ha gave maximum plant height (82.21 cm), number of leaves per plant (63.52) and number of tillers per hill (20.18).

The growth parameters recorded periodically have exhibited interesting architectural variation due to different concentration of phosphorus. Growth and development of rice, which is characterized by determine growth habit of crop were studied periodically. The vegetative and reproductive development of the crop culminating into economic yield was the terminal outcomes of growth, which was affected by continuously interaction acquiring between environment and plant physiological process. The positive effect of phosphorus on growth character due to its favourable effect on growth and augmenting cell division and cell expansion. Phosphorus plays a crucial role in meristematic growth through its effect on the synthesis of phyto-hormones. These results are in conformity with the findings of Mathukia et al. (2014), Arshad et al. (2016), Irfan et al. (2016), Sarkar et al. (2018), Goswami et al. (2019) and Goswami and Maurya (2020).

Phosphorus is involved in root growth. It also plays an active role in formation of high energy phosphate which are unstable in water and act as carrier for vital reactions like oxidation of sugars through enhancing enzymatic activities and in initial reaction for photosynthesis etc. Similar results have also been reported by Murumkar et al. (2015), Noonari et al. (2016), Niaz et al. (2018) and Ghetiya et al. (2019).

Thus, better nutritional environment in plant under the influence of application of higher fertility levels i.e. 90 kg P_2O_5 + KSB @ 400 ml/ha to rice crop might have enhanced meristematic activities in plant thereby increased division, enlargement and elongation of cells resulting in higher plant height. The larger canopy development on account of higher number of tillers/ plant and plant height under application of 90 kg P2O5 + KSB @ 400 ml/ha might have increased interception, absorption and utilization of radiant energy resulting in higher photosynthesis and finally increasing all the growth attributes. Similar results have also been reported by Murumkar et al. (2015), Noonari et al. (2016), Niaz et al. (2018) and Ghetiya et al. (2019).

Data regarding length of panicle, number of grains per panicle, number of filled grain per panicle, test weight, grain & stover yield of rice are reported in Table 1 and maximum values were observed when crop fertilized with increasing rate of phosphorus @ 90 kg/ha as well as KSB application @ 400 ml/ha. Statistical analysis of the data revealed that highest length of panicle (26.92 cm), number of grains per panicle (183.07), number of filled grain per panicle (170.67), test weight (25.86 g), grain yield/ha (52.47 q/ha) and stover yield/ha (90.40 q/ha) recorded under the treatment combination of phosphorus @ 90 kg/ha with application of KSB @ 400 ml/ha. While, lowest values were observed in plot that received no phosphorus with application of KSB @ 0 ml/ha.

The yield of crop largely depends upon the source-sink relationship i.e. mobilization of photosynthates from the synthesis sites and temporary storage organs towards the developing grains. The different components of sources are leaf area, number of leaves, number of tillers before anthesis and that of sink are number of panicles/ plant, length of panicle, number of grains/ panicle and 1000- grain weight. The overall trends evidently indicate that the progressive increase in number of grains per panicle among the treatment was inconsistent. Secondly, there were significant variations in their grains per panicle. Significant variation was observed on the number of grains per panicle of rice when the field was fertilized with different doses of phosphorus. This might be due to the fact that plant treated with optimum phosphorus doses, resulting increased the tillers through better root development and more nutrient availability, resulting in vigorous plant growth and dry matter accumulation leading to flowering, fruiting and grain formation as well as number of grains per panicle. This was in line with the results reported by Verma et al. (2016), Shalini (2017), Niaz et al. (2018) and Ghetiya et al. (2019).

Number of grains per panicle indicated that there was a significant influence by application of increasing rate of P_2O_5 and KSB on total grains per panicle. This might be due to the reason that the in the presence of ammoniacal fertilizers increases the phosphorus uptake because of the synergistic effect between phosphorus and KSB and the phosphorus exhibits a decisively beneficial influence on formation of grains. This increase in total number of grains with additional dose of phosphorus might be due to the reason that P which was absorbed during the vegetative growth period was most efficiently utilized for grain production. Phosphorus is needed in the early growth stages as if sufficient P is absorbed in the early stages, it can be translocated to growing organs and the partial productive efficiency of phosphorus for grain is higher at early stages than at later stages. Similar findings have also been reported by Rajiv et al. (2017), Pradeep et al. (2017), Raghavendra et al. (2018) and Biswas and Shivaprakash (2019).

Table 1: Effect of Phosphorus and KSB Levels on Growth and Yield of Rice

Treatment	Plant height (cm)	Number of leaves per Plant	Number of tillers per hill	Length of panicle (cm)	Number of grains per panicle	Number of filled grain per panicle	Test weight (g)	Grain yield (q/ha)	Stover yield (q/ha)
	Effect of phosphorus								
P_0	72.85	53.96	17.62	21.63	143.89	138.27	22.51	32.88	83.66
P_1	80.00	59.78	19.64	23.69	166.31	154.40	23.20	39.12	85.06
P_2	84.55	63.87	20.27	25.36	175.40	160.31	23.89	49.60	88.38
P_3	86.53	66.76	20.80	26.10	179.62	166.27	24.68	51.60	89.95
S. Em±	2.12	0.37	0.58	0.39	2.72	2.42	0.44	2.38	1.08
CD	6.23	1.07	1.69	1.15	7.97	7.08	1.29	6.97	3.15
	Effect of KSB								
K_1	79.53	58.25	18.95	23.47	159.68	149.75	23.15	40.80	85.69
K_2	81.20	61.50	19.62	24.20	168.42	155.62	23.52	43.51	87.05
K_3	82.21	63.52	20.18	24.91	170.82	159.07	24.04	45.60	87.55
S. Em±	2.45	0.32	0.66	0.45	3.14	2.79	0.51	2.74	1.24
CD	7.19	0.93	1.95	1.32	9.20	8.18	1.49	8.05	3.64
	Interaction effect between phosphorus and KSB								
P_0K_1	70.21	49.87	16.33	20.46	130.60	129.67	22.09	27.64	83.22
P_0K_2	73.60	54.93	17.53	21.59	149.67	138.47	22.63	32.53	83.63
P_0K_3	74.73	57.07	19.00	22.85	151.40	146.67	22.81	38.47	84.13
P_1K_1	77.02	57.47	19.53	22.97	161.93	152.73	23.06	38.64	84.77
P_1K_2	79.15	60.33	19.60	23.80	167.40	154.07	23.25	38.83	84.93
P_1K_3	83.82	61.53	19.80	24.29	169.60	156.40	23.30	39.89	85.47
P_2K_1	85.28	62.33	19.87	24.95	171.47	156.80	23.63	46.44	85.58
P_2K_2	85.35	63.60	20.33	25.54	175.53	161.60	23.84	50.81	89.38
P_2K_3	83.01	65.67	20.60	25.59	179.20	162.53	24.19	51.56	90.19
P_3K_1	85.62	63.33	20.07	25.51	174.73	159.80	23.81	50.47	89.17
P_3K_2	86.70	67.13	21.00	25.87	181.07	168.33	24.36	51.86	90.26
P_3K_3	87.27	69.80	21.33	26.92	183.07	170.67	25.86	52.47	90.40
S. Em±	1.23	0.63	0.33	0.23	1.57	1.39	0.25	1.37	0.62
CD	2.54	1.85	0.69	0.47	3.25	2.89	0.53	2.84	1.29

Acknowledgement

Authors are thankful to Dr. T. Singh Prof. and head agronomy for very kindly providing all the experimental facilities and suggestions for successful conduct of the experiment.

REFERENCES

Annual Report, (2016-17). Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, *Government of India. 3*.

Arshad, M., Adnan, M., Ahmed, S., Khan, A. K., Ali, I., Ali, M., Ali, A., Khan, A., Kamal, M. A., Gul, F., & Khan, M. A. (2016). Integrated effect of phosphorus and zinc on wheat crop. *American-Eurasian J. Agric. & Environ. Sci. 16* (3), 455-459.

Sanjukta, B., & Shivaprakash, M. K. (2019). Comparative Studies of Concomitant Release of Secondary and Micronutrients by Potassium Solubilizing Bacteria (KSB) from Different Minerals. *Ind. J. Pure App. Biosci. 7* (4), 341-345.

G. O. I. (Government of India, Ministry of Agriculture and Farmer's Welfare) (2017). Annual Report 2016-2017. Government of India, Ministry of Agriculture and Framer's Welfare, Krishibhavan, New Delhi, Pp.194.

Ghetiya, K. P., Bhalu, V. B., Mathukia, R. K., Chovatia, P. K., & Hadavani, J. K. (2019). Effect of Phosphate and Potash Solubilizing Bacteria on Nutrient Uptake, Quality Parameter and Economics of Popcorn (Zea mays L. Var. Everta). *Int. J. Pure App. Biosci. 7* (1), 216- 223.

Puri, G. S., & Maurya, B. R. (2020). Impact of potassium solubilizing bacteria (KSB) and sources of potassium on yield attributes of maize (Zea mays L). *Journal of Pharmacognosy and Phytochemistry, 9* (1), 1610- 1613.

Irfan M., Memon, M. Y., Shah, J. A., & Abbas, M. (2016). Application of nitrogen and phosphorus in different ratios to affect paddy yield, nutrient uptake and efficiency relations in rice (Oryza sativa L.). *J. Environ. Agric. 1* (2), 79– 86.

IRRI (2014). World rice statistics. http://ricestat.irri.org:8080/wrsv3/entrypoint.htm.

Mathukia, R. K., Chodhary, R. P., Shivran, A., & Bhosale, N. (2014). Response of rabi sweet corn to plant geometry and fertilizer. *Current Biotica, 7,* 294-298.

Murumkar, S. B., Pawar, G. R., & Naiknaware, M. D. (2015). Effect of different sources and solubility of phosphorus on growth, yield and quality of kharif rice. *International Journal of Tropical Agriculture, 33* (2), 245-249.

Sial, N. A., Abro, S. A., Abbas, M., Irfan, M., & Depar, N. (2018). Growth and yield of wheat as affected by phosphate solubilizing bacteria and phosphate fertilizer. *J. Biotechnology. 15* (2), 475- 479.

Noonari, S., Kalhoro, S. A., Ali, A., Mahar, A., Raza, S., Ahmed, M., Shah, S. F. A., & Baloch, S. U. (2016). Effect of different levels of phosphorus and method of application on the growth and yield of wheat. *Natural Science, 8,* 305-314.

Kumar, P., Singh, S., Shukla, R. D., & Singh, V. (2017). Effect of NPK and biofertilizer on growth and yield of barley (Hordium vulgare L.) in western Uttar Pradesh. *Progressive Research – An International Journal, 12* (Special issue-IV), 2434- 2437.

Raghavendra, M., Singh, Y. V., Das, T. K., & Meena, M. C. (2018). Effect of crop residue and potassium management practices on productivity and economics of conservation agriculture-based maize (Zea mays)- wheat (Triticum aestivum) cropping system. *Indian Journal of Agricultural Sciences, 87* (7), 855- 61.

Umrao, R., Limanpure, Y., Bijalwan, A., & Manmohan Dobriyal, J. R. (2017). Effect of different levels of inorganic fertilizers on the growth and yield of Barley (Hordeum vulgare) under teak (Tectona grandis) based Agrisilviculture system. *New York Science Journal, 10* (5), 34- 38.

Sudip, S., Surbala Devi, N., Singh, A., & Yimjenjang Longkumer, I. (2018). Effect of single super phosphate and rock phosphate on growth & yield of rice. *Journal of Pharmacognosy and Phytochemistry, 7* (2), 3654- 3656.

Kumari, S. (2017). Effect of Nitrogen and Phosphorus Level on Dry Matter Yield at Different Growth Stages of Popcorn in South Saurashtra Region of Gujarat, India. *International Journal of Current Microbiology and Applied Sciences, 6* (8), 547- 553.

Srinivasarao, Ch., Veni, V. G., Sharma, K. L., & Raju, B. M. K. (2015). Phosphorus fertility status and strategies to improve its use efficiency in Indian soils. *Indian Journal of Fertilizers, 11* (3), 22-36.

Anukriti, V., Patidar, Y., & Vaishampayan, A. (2016). Isolation and purification of potassium solubilizing bacteria from different regions of India and its effect on crop's yield. *Indian J Microbiol Res, 3*(4), 483- 488.