Original Research Article

Phosphorus Requirement of Timely Sown Irrigated Wheat

S. M. Kurmvanshi[*], B. M. Maurya, R. K. Tiwari and Ashok Suryawanshi

Department of Agronomy, College of Agriculture, JNKVV, Rewa, M.P. – 486001, India

*Corresponding author

A B S T R A C T

The Experiment on phosphorus requirement of timely sown irrigated wheat was conducted during 2020-21 under All India coordinated research project on farming system Kuthulia Farm, College of agriculture, JNKVV, Rewa (M.P).. The study reveals that wheat variety GW 322 gave higher yield, gross returns, net return and B.C. ratio as compared to wheat variety JW 3382. Application of 60 kg, P_2O_5 /ha gave maximum B:C ration 3.05 under timely sown irrigated wheat. The phosphorus requirement was 58.50 kg P_2O_5/ha for maximum yield 51.05 q./ha @ 27.8 kg grain/ kg P_2O_5, while opti-mum dose of Phosphorus was 43.8 kg P_2O_5 /ha for timely sown irrigated wheat.

Introduction

Wheat is one of the important staple food crop and widely cultivated leading cereals both in acreage and in production among the grain crops of the world. More than one- third of the world population is feed by wheat.

In Inida wheat crop is grown in 31.36 million ha, which produced 97.85 million tonnes of grain with the average productivity of 3415 kg ha^{-1}, The area and production of wheat in 2022-21 increased by 6.95% and 4.11%, respectively as compared to 2019-20 (USDA, 2021). In the state of Madhya Pradesh, wheat is grown in about 5.52 million hectares area with the production of 15.47 million tonnes which clearly indicates that the productivity

of wheat is quite low i.e. 2807 kg/ha than national average (Anonymous, 2019).

Proper nutrition is a key for maximizing wheat yields. Phosphorus is essential nutrients in plants and plays an important role in many physiological processes. Phosphorus deficiency is a yield reducing factor in fertilized soil, particularly soils high in calcium carbonate, which reduces phosphorus solubility, Phosphorus fertilizer is an important element in crop production is well established.

Applied phosphate fertilizer can only move 3-5 cm in soil. Phosphorus utilization efficiency is 15-20% remaining phosphorus is fixed by different soil. Therefore balance fertilizer at proper time is essential. Phosphorus requirement for timely sown

irrigated wheat has not studied in Rewa region. Keeping above facts in view present experiment was taken.

Materials and Methods

The present experiment was conducted on silty clay loam soil of Kuthulia Farm, College of Agriculture, JNKVV, Rewa during *rabi* season of 2020-21 under All India Coordinated Research Projects on Farming system. The soil of the experimental field was neutral in reaction (Ph 7.1), low in organic carbon (0.39%), low in available nitrogen (163.8 kg/ha) and medium in available phosphorus and potash.

Two wheat varieties GW 322 and JW 3382 were taken as test varieties under the phosphorus level 0kg/ha, 30 kg/ha, 60kg/ha and 90 kg P_2O_5/ha. Total eight treatments were arranged in factorial randomized block design with three replication.

All the recommended package of practices were adopted for irrigated wheat. Common dose of potash and nitrogen were given under all the treatment. The crop was planted on 20.11.2020.

Grain yield of wheat was subjected to single degree analysis to see the response of phosphorus in which linear and quadratic response were found significant. Hence quadratic regression equation was developed which was

$$Y = a + bX + C X^2$$

Where a, b, and C are constant to be estimated and X in the Interval between the levels.

Response of Phosphorus

The response of P_2O_5 was computed by following equation

$$\text{Response of } P_2O_5 \text{ V} = \frac{b x - cx^2/}{x} = \frac{}{X}$$
$$\text{(Kg grain per Kg } P_2O_5)$$

X Maxima

Maximum level of P_2O_5 was computed by following equation.

$$\text{X maxima} = \frac{-b}{2C} \times X \quad X = kg/ha$$
$$\text{kgP}_2O_5/\text{ha}$$

Yield at X Maxima

The maximum level of yield was estimated by putting the value X maximum in quadratic regression equation.

X Optima

It is that level of P_2O_5 which is capable of giving maximum net return which was estimated with following equation

X aptima with following equation

$$\text{X optima} = \frac{b - \dfrac{\text{Price of } P_2O_5 \text{ Rs/ha}}{\text{price of grain Rs/ha}}}{-2C}$$
$$= kg/ha$$

Results and Discussion

Effect on yield attributes

Yield attributing characters of wheat has been given in Table 1 which reveals that wheat variety G-W 322 gave 10.61 % higher number of productive tillers as compared wheat variety JW 3382. Productive tillers M^2 was significantly maximum at 30, 60 and 90 kg P_2O_5 as compared to no phosphorus application. Productive tiller 555.34/ m^2 was maximum at 90 kg P_2O_5 /ha but it was at par to 60 kg P_2O_5 /ha.

Number of grains / earhead and grain yield / ear head were maximum in wheat variety GW 322 which was 13.19% higher than wheat variety JW

3382. Grain yield per ear head was significantly maximum at 90 kg P2O5. But there was no significant difference at 30, 60 and 90 kg P_2O_5 /ha.

Test weight of wheat variety GW 322 was maximum (45.3 g/1000 grain) which was higher than wheat variety JW 3382.

Application of phosphorus @ 90 kg P_2O_5 /ha gave significantly higher test weight (45.93 g/ 1000 grain) as compared to no phosphorus applications. It may be due to varietal differences in response to yield attributing characters Kurmvanshi *et al.,* 2018 and Suryawanshi (2020) have also reported positive response of phosphorus at 80 kg P_2O_5 /ha on yield contributing characters of wheat while varietal differences in yield attributing characters were reported by Surywanshi (2020)

Effect on yield

Grain and straw yield of wheat have been presented in Table 2 make it clear that grain yield of wheat variety GW 322 was 5293 kg/ha which was 8.84%

higher than wheat variety JW 3382 It may be due to varietal differences and superior yield contribution characters of wheat variety GW 322 by which productive tillers were increased by 10.61%, grain yield / ear head by 13.19% and test weight by 2.02 % over wheat variety JW3382. Combine effect of all these characters increased the grain yield by 8.84% in wheat variety GW 322 such varietal differences were also reported by Suryawanshi (2020)

Application of phosphorus at 90 kg P_2O_5 gave maximum grain yield 5720 kg /ha which was 32.19% higher as compared to no phosphorus application. Application of 60 kg of P_2O_5 was at par to 90 kg P_2O_5 /ha but were significantly superior than lower levels of P application. It is because of fact the P improved the physical conditions of soil by witch superior attributing characters like number of productive tillers /m^2, number of grains/ spike grain yield / spike and test weight were increased at higher level of phosphorus. Similar finding were also reported by Kurmvanshi *et al.,* (2018) and Suryawanshi 2020. Similar trend in straw yield was also reported.

Table.1 Number of grains ear $^{-1}$ grain yield (g ear^{-1}) and test weight (g) of wheat as influenced by various varieties and phosphorus levels.

Treatment	Number of grains ear-1	Grain yield (g ear-1)	Test weight (g)
Varieties			
V1- GW 322	58.04	2.66	45.30
V2- JW 3382	60.94	2.35	44.40
SEm+	0.29	0.03	0.06
CD at 5%	0.87	0.09	0.18
Phosphorus levels			
P$_0$- 0 kg P2O5 /ha	54.48	2.39	43.97
P$_1$- 30 kg P_2O_5 /ha	57.98	2.50	44.90
P$_2$- 60 kg P_2O_5 /ha	60.40	2.54	45.93
P$_3$- 90 kg P_2O_5 /ha	65.09	2.59	44.06
SEm+	0.57	0.06	0.12
CD at 5%	1.73	0.18	0.35
Interaction (VXP)	NS	NS	NS
V= Varieties, P = Phosphorus levels , NS = Non – Significant			

Table.2 Grain yield (kg ha-1), Straw yield (kg ha-1) and harvest index (%) of wheat as influenced by various varieties and phosphorus levels.

variety	Grain yield (kg ha^{-1}),					straw yield (kg ha^{-1})					HI (%)				
	0 kg P_2O_5 kg/ha	30 kg P_2O_5 kg/h	60 kg P_2O_5 kg/ha	90 kg P_2O_5 kg/ha	Mean	0kg P_2O_5 kg/ha	30 kg P_2O_5 kg/h	60 kg P_2O_5 kg/ha	90 kg P_2O_5 kg/ha	Mean	0 kg P2O5 kg/ha	30 kg P_2O_5 kg/h	60 kg P_2O_5 kg/ha	90 kg P_2O_5 kg/ha	Mean
GW 322	4517	4910	5833	5910	5293	5573	5640	6940	7989	6535	4426	46.91	45.73	42.15	44.81
JW 3382	3958	6309	4922	6779	4563	6501	5919	7938	7688	7282	38.85	37.93	41.25	42.01	40.01
Mean	4327	4588	5676	5720		6037	6280	7439	7839		41.65	42.42	43.49	42.08	
	V		P		VxP	V		P		VxP	V		P		VxP
SEm+	67.25		134.49		268.98	78.21		152.43			0.35		0.70		
CD at 5%	203.96		407.91		815.83	231.18		462.32		NS	1.06		2.12		NS

Table.3 Cost of cultivation, gross return, net return and B: C ratio

Treatments	Cost of Cultivation q/ha	Gross return (Rs.)	Net profits /ha	B:C ratio
(a) Variety				
GW 322	27935	107775	79840	2.85
JG 3382	28435	100075	71715	2.51
(b) P levels P₂O₅ kg/ha				
0	28685	88735	62050	2.32
30	27685	93995	66310	2.40
60	28685	115801	87266	3.05
90	29685	117169	87484	2.95

Table.4 Response of phosphorus, maximum and optimum phosphorus requirement of wheat

Equation	Yield maxima at X- maxima (Q ha-1)	X- maxima (Kg ha-1)	X- optima (kg ha-1)	Response kg grain/kg P_2O_5
Y= 48.83 + 3.21 x-0.82 x^2	51.092	58.5	43.8	27.81

Gross and Net Profit

Gross and net profit of wheat varieties under varying level of phosphorus have been given in Table 3. It is evident that gross return Rs. 107775, Net profit 79840 and B:C ratio 2.85 were higher in wheat variety GW 322 while JW 3382 wheat variety gave poor economics as compared to GW 322. Application of 60 kg P_2O_5 /ha gave net profit Rs. 87266 / ha and B:C ratio 3.05 which was maximum as compared to others tested levels.

Phosphorus need of wheat

Regression equation was calculated on the basis of pooled basis which is Y= 48.83+ 3.21X-.82x^2 as given in Table 4. Maximum dose of phosphorus was 58.5 kg P_2O_5 /ha which gave maximum yield 51.01 q/ha @ 27.81 kg grain /kg P_2O_5 while optimum dose of phosphorus was 43.8 kg P_2O_5/ha.

References

Anonymus (2019) Agricultural statistics at a glance are http: *II* eands. dacnet. nic.in

Kurmvanshi, S. M. Maurya, B. M., Tiwari R. K., (2018) Long term effect of chemical fertilizer in Rice – Wheat cropping system under irrigated condition of Kyamoe satpura agro climate zones Int. J. Current. Microbiology and App. Sci. 7 (8) : 3918-3925

Surywanshi Ashok (2020) Studies on phosphorus requirement of timely sown irrigated wheat verities M.Sc. Ag. Thesis submitted to JNKVV, Jabalpur (M.P.)