Effect of Different Levels of Nitrogen and Phohphorus on Growth, Yield and Quality of Wheat Under Irrigated Conditions

RAKESH CHIKHALKAR[1], AMBARISH THAOKAR[2], KEVIN A. GAWALI[3]
[1]*P. G. Student, Agronomy Section, School of Agricultural Sciences, G H Raisoni University, Saikheda*
[2]*Assistant Professor, Agronomy Section, School of Agricultural Sciences, G H Raisoni University, Saikheda*
[3]*P. G. Student, Agronomy Section, College of Agriculture, Nagpur*

Abstract— At the Agronomy Farm, Department of Agronomy, School of Agricultural Sciences, G.H. Raisoni University, Saikheda, Pandhurna (M. P.), a field experiment was carried out in Rabi, 2023–24 on clayey soil to investigate the effects of varying levels of nitrogen and phosphorus on the growth, yield, and quality of wheat under irrigation. Seven treatments made up the experiment, which was triple duplicated in RBD Design. As a result, wheat growth and yield qualities as well as protein content were found to be greatly enhanced by application of 150:125:00 (NPK) kg ha-1 (T5), and this treatment was shown to be comparable to treatments 175:150:00 (NPK) kg ha-1 (T6) and 200:150:00 (NPK) kg ha-1 (T7).

Index Terms- Wheat, Nitrogen, phosphorus, performance, Triticum aestivum L.

I. INTRODUCTION

About 35% of India's food grain production comes from the crop known as wheat (Triticum aestivum L.), which is ranked second in importance only to rice (Oryza sativa L.). After China, India is the world's second-largest producer of wheat (77.6 million tons) and has an area of 27.7 million hectares.

Despite being grown over a vast expanse of land in India, the average yield of wheat is only 3.0 tons/ha-1. The states of Gujarat, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal are the principal producers of wheat in the nation. With an 8.71 and 9.06% share of the nation's area and output, respectively, Madhya Pradesh comes in third place for area and fourth place for production. This crop is grown on 9829 thousand hectares of land in Madhya Pradesh, where it yields 35666 thousand tons of produce annually and 3629 kg/ha of yield (Anonymous 2022).

To increase wheat crop productivity, agronomic practices and fertilizer use must be balanced. In order to get improved yields in crop nutrition, the function of macro and micronutrients is critical (Raun and Jhonson, 1995). India's soils lack sufficient amounts of nitrogen, so chemical fertilizers are added to improve crop yields. Nutrients in balanced forms, such as N, P, K, S, and Mg, are necessary for the primary processes of plant development and yield generation (Randhawa and Arora 2000).

The two main components that increase yield are phosphorus and nitrogen since they encourage the vegetative growth of plants. One of the fundamental components needed to increase wheat yield is nitrogen. It plays a major role in the manufacture of essential chemicals like as protein and chlorophyll, which are involved in every physiological and biochemical function in plants. The reaction to N fertilization differs depending on the following factors: soil type and features, climate, crops and their types, rate, timing, and placement of fertilizer application (Mengel and Kirkby, 1978). One of the minerals that is necessary for crop production and plant growth is phosphorus. According to Zubillaga et al. (2002), higher P levels improved production and nitrogen usage efficiency.

Numerous studies have examined the role of phosphorus in the metabolism of lipids and carbohydrates as well as in cellular respiration. In addition to increasing output, balanced and appropriate fertilization of wheat and rice has a positive effect on the crop plants' uptake of phosphorus (Rehman et al. 2006). In light of these facts, the current study aimed to ascertain how wheat's development and output responded to varying levels of phosphorus and nitrogen.

Globally, chemical fertilizers have been instrumental in raising crop yields. Pakistan's calcareous and alkaline soils have low levels of phosphate and nitrogen. As a result, since their introduction in the late 1950s, the use of fertilizer containing phosphorus and nitrogen has multiplied (Ahmad, 2000). The addition of optimal phosphorus through soil application resulted in a considerable improvement in wheat grain yield and yield contributing characteristics (Rahim et al., 2010).

Thus, research is being done to increase wheat output by varying the amounts of phosphorus and nitrogen in wheat. The following goals were pursued during a field experiment conducted during the rabi season in the student research field of the agronomy department at the G. H. Raisoni University's school of agricultural sciences in Sausar, Pandhurna, Madhya Pradesh:

II. MATERIAL AND METHODS

The field experiment was carried out in Rabi 2023–2024 at the Agronomy Farm, School of Agricultural Sciences, Department of Agronomy, G.H. Raisoni University, Saikheda, Pandhurna (M. P.). With three replications and seven treatments, the experiment was set up using randomized block design (RBD). The treatment consists of T_1- Control 0:0:0 (NPK) kg ha^{-1}, T_2- 75: 50:00 (NPK) kg ha^{-1}, T_3- 100: 75:00 (NPK) kg ha^{-1}, T_4- 125:100:00 (NPK) kg ha^{-1}, T_5- 150:125:00 (NPK) kg ha^{-1}, T_6- 175:150:00 (NPK) kg ha^{-1} and T_7- 200:150:00 (NPK) kg ha^{-1}.

In each treatment, every agronomic management technique was applied consistently. Aside from pre-sowing irrigation, six irrigations were administered during the cropping period. Five plants, randomly tagged in each treatment and replication, were used to record the plant height data. Number of effective tillers per meter row length, ear head length (cm), number of grains per ear head, 1000 grain weight, biological, grain, and straw yield were the yield variables that were observed and reported. The yields of grain and straw were recorded in accordance with established protocol. The ratio of biological to economic yield, or the Harvest Index, was computed and reported as a percentage of age as shown below.

$$\text{Harvest Index (HI)} = \frac{\text{Economic yield (kg ha}^{-1})}{\text{Biological yield (kg ha}^{-1})} \times 100$$

III. RESULT AND DISCUSSION

Growth attributes

Growth characteristics such as plant height, tiller count, and dry matter output plant-1 showed a considerable increase at 150:125:00 (NPK) kg ha-1 application (T5). Table 1 displays the results of the analysis and recording of plant height data. Plant height was shown to be relevant at harvest time. Plant height (97.54 cm) was higher when 150:125:00 (NPK) kg ha-1 (T5) was applied. It matched the application of 200:150:00 (NPK) kg ha-1 (T7) and 175:150:00 (NPK) kg ha-1 (T6) almost equally. The reason for the increase in plant height at medium and high fertilizer levels might be attributed to the availability of enough nourishment, which led to a rise in the plants' vegetative development. Kausar et al. (1993) obtained similar results.

Table 1: Different nutrient levels influence the growth characteristics of wheat.

Treatments		Plant height (cm)	No. of tillers plant^{-1}	Dry matter production plant^{-1}
T_1	Control 0:0:0 (NPK) kg ha^{-1}	81.00	47.20	114.92
T_2	75: 50:00 (NPK) kg ha^{-1}	85.23	50.08	116.27
T_3	100: 75:00 (NPK) kg ha^{-1}	89.35	50.22	117.31

T_4	125:100:00 (NPK) kg ha^{-1}	90.47	51.78	120.11
T_5	150:125:00 (NPK) kg ha^{-1}	97.54	55.07	122.53
T_6	175:150:00 (NPK) kg ha^{-1}	94.23	54.42	122.13
T_7	200:150:00 (NPK) kg ha^{-1}	92.23	53.32	121.77
	SE (m) ±	0.46	0.64	0.58
	CD at 5%	1.39	1.89	1.62
	GM	90.00	51.72	119.29

Table 1 displays the data that was recorded on the quantity of tillers for each plant. At harvest, there were noticeably more tillers per plant (55.07) at 150:125:00 (NPK) kg ha-1 (T5). Applying 175:150:00 (NPK) kg ha-1 (T6) and 200:150:00 (NPK) kg ha-1 (T7) was comparable. When N fertilizers are applied, these parameters rise. This is likely because there is more nitrogen available, which leads to more leaf area, higher photoassimilates, and faster conversion of synthesized carbohydrates into protein. All of these factors increase the number and size of growing cells, which in turn increases the number of tillers (Singh and Agarwal, 2001).

Table 1 displays the data that was collected, examined, and discovered on dry matter production plant-1. At harvest, a considerably maximum application of 150:125:00 (NPK) kg ha-1 (T5) was recorded (122.53 g). Applying 175:150:00 (NPK) kg ha-1 (T6) and 200:150:00 (NPK) kg ha-1 (T7) was comparable.

Yield attributes

A considerable increase in yield features, such as the number of spike/plants, grain and straw yields/hectare, and protein content, was observed when 150:125:00 (NPK) kg ha-1 (T5) was applied. However, this level of yield was comparable to that of 175:150:00 (NPK) kg ha-1 (T6) and 200:150:00 (NPK) kg ha-1 (T7). (Table 2).

The application of 150:125:00 (NPK) kg ha-1 (T5) resulted in the highest number of spikes per plant, while it was comparable to 175:150:00 (NPK) kg ha-1 (T6) and 200:150:00 (NPK) kg ha-1 (T7). One of the most significant roles of N is to promote vegetative development, which explains the improved growth and increased biological yield with rising N levels (Ma et al. 2004). The majority of the crop's yield was increased by the improvement in yield characteristics. Along with a rise in N level, these metrics also increased.

Table 2 shows the yield data that was collected, examined, and reported. While applying 150:125:00 (NPK) kg ha-1 (T5) resulted in a considerable increase in the maximum grain yield (3784 kg ha-1) and straw yield (5412 kg ha-1), these yields were comparable to those obtained with 175:150:00 (NPK) kg ha-1 (T6) and 200:150:00 (NPK) kg ha-1 (T7). (Table 2). When administered in an equal amount to nitrogen, phosphorus appears to have an additive influence on crop growth (Bhatti et al., 1988 and Brink, 2001). The development of the reproductive portion of the seed, particularly when a considerable amount of phosphorus was available, may have occurred from optimal nutrient availability during seed filling, which allowed for the maximum grain yield at the greatest level of P2O5.

In comparison to the control, the protein content increased significantly in the treatments when nitrogen fertilizers were utilized in combination. With the exception of 175:150:00 (NPK) kg ha-1 (T6) and 200:150:00 (NPK) kg ha-1 (T7), all treatments were considerably superior to the maximum protein content (22.62%), which was recorded with 150:125:00 (NPK) kg ha-1 (T5). Increases in NPK fertilizer levels were similarly linked to higher grain protein content, according to studies by Jamro et al. (1992) and Imtiaz et al. (1995).

Table 2: Different nutrient levels influence the yield characteristics of wheat.

Treatments	Number of spikes	Grain yield ha^{-1}	Straw yield ha^{-1}	Protein conten

		plant^{-1}	(kg)	(kg)	t (%)
T	Control	2.2	15	23	41
T_2	75: 50:00 (NPK) kg ha^{-1}	2.33	1615	2382	4160
T_3	100: 75:00 (NPK) kg ha^{-1}	2.73	2064	3013	4085
T_4	125:100:00 (NPK) kg ha^{-1}	2.90	2340	3405	3520
T_5	150:125:00 (NPK) kg ha^{-1}	3.86	3784	5412	3745
T_6	175:150:00 (NPK) kg ha^{-1}	3.17	2929	4203	3548
T_7	200:150:00 (NPK) kg ha^{-1}	3.17	2851	4105	3420
	SE (m) ±	0.27	319	460	129
	CD at 5%	0.80	949	1368	260
	GM	2.92	2450	3548	3809

CONCLUSION

150:125:00 (NPK) kg ha-1 application (T5) measured higher than all other treatments for the following growth and yield attributes of sesame: plant height, number of branches per plant, dry matter accumulation per plant, number of capsules per plant, grain yield per kilogramme, straw yield per kilogramme, and protein content. However, it was comparable to 175:150:00 (NPK) kg ha-1 (T6) and 200:150:00 (NPK) kg ha-1 (T7).

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