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Wheat Growth and Yield Contributing Characters under Various Sources and Schedules of Nitrogenous Fertilizer

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Abstract: The field trial was conducted to assess the effect of source and schedule of nitrogenous fertilizer on wheat growth and yield contributing characters, at Latif Experimental Farm, Sindh Agriculture University Tandojam, Pakistan. Wheat variety Sarsabz was drilled to test various nitrogenous fertilizers (urea, ammonium nitrate and ammonium sulphate) applied in two and three splits with basal dose of P and K. The results revealed that nitrogen applied in three split doses significantly increased plant height, number of tillers, size of earhead, seed index and grain and straw yields as compared to two split applications. Among the sources of nitrogen, urea was ranked at first place as compared to ammonium nitrate and ammonium sulphate fertilizers for growth and yield contributing characters. Therefore, it is recommended that urea is the best source of nitrogen and it should be applied in three split doses during the whole wheat crop growth stages for obtaining satisfactory straw and grain yields.

Key Words: Wheat, Urea, Ammonium Nitrate, Ammonium Sulphate, Growth, Yield

Introduction

Wheat *Triticum aestivum* is an important cereal crop and is the staple food for most of the world's population. The present level of production of production of wheat of Pakistan is very low as compared to other wheat growing countries of the world. Among the constraint of low yield, appropriate fertilizer selection and timely application are considered main factors. Much research has been done on the use of nitrogen fertilizer but less attention is given on sources and methods of nitrogen fertilizer application in wheat crop. Nitrogen plays an important role in plant growth and provides help in promotion of uptake of other elements in plant. Wheat is much responsive to split nitrogen application by significant increase in plant height, tiller production, size of earhead, seed index, which in-turn had positive effect on the production of grain and straw yields (Tila Muhammad *et al.*, 1987). Among the sources of nitrogen fertilizer urea requires generally adequate moisture for its uptake by the plants, whereas, ammonium nitrate and ammonium sulphate can be used by the plant under low moisture conditions. It was further reported that urea was the best source of nitrogen fertilizer for achieving higher wheat crop grain and straw yields as compared to other nitrogen sources available in the market (Palmer and Madge, 1982). The guidelines for maximum economic yield of wheat production suggests that split applications of nitrogen should be performed as, 40% pre-plant, 10% in starter, 25% at tillering and 25% at stem elongation. An additional nitrogen application of about 17-22 kg ha^{-1} at swollen boot stage can have significant effects on head fill and grain protein levels (McKenzie, 2002).

The exploration of new high yielding varieties in the country need to test different nitrogen sources during whole crop growth stages to obtain the satisfactory crop production. Looking the economic importance of the wheat crop, the research is an attempt to explore the best nitrogen source for obtaining maximum grain and straw yield of the wheat crop.

Materials and Methods

The field experiment was conducted at Latif Experimental Farm, Sindh Agriculture University Tandojam, to study the effect of source and schedule of nitrogen fertilizer on growth, yield and quality characters of wheat. The experiment was laid out in Randomized Complete Block Design (Factorial arrangement) with four replications. The treatment details are as under:

Fertilizer Source
S1 = Urea (46% N)
S2 = Ammonium nitrate (26 % N)
S3 = Ammonium sulphate (28 % N)

Method of Application
M1 = Two Splits
1st split 50 kg N ha^{-1}
2nd split 50 kg N ha^{-1}
M2 = Three Splits
1st split 33.3 kg N ha^{-1}
2nd split 33.3 kg N ha^{-1}
3rd split 33.3 kg N ha^{-1}

Fertilizers

Nitrogen: Nitrogen was applied as sources (urea, ammonium nitrate and ammonium sulphate) in two splits (1st at sowing, second at 1st irrigation) and in three splits (1st at sowing, 2nd at 1st irrigation and third at ear heading).

Phosphorus: The basal dose of 75kg P_2O_5 ha^{-1} was applied in each treatment in the form of S.S.P.

Potash: All required quantity of potash (25kg ha^{-1}) was applied in all the polts before sowing in the form of murate of potash.

Irrigation: First irrigation was given after 15 days of sowing and subsequent irrigations were applied on the requirement of crop (Total 5 irrigations were applied).

Weeding: The pots were kept free of weeds by hand weeding, throughout the growing period of crop as to avoid the uptake of applied fertilizer nutrients by weeds.

Soil Sampling: Soil samples were taken from experimental field before the sowing, samples were taken at the depth of 0-30 cm. The samples were taken with post hole type augar. They were air dried, ground, sieved through 2mm sieve and analyzed for physico-chemical properties.

Statistical Analysis of the Data: The data recorded was tabulated and subjected to statistical analysis of variance, to discriminate the treatment means. L.S.D test was applied following Steel and Torrie (1980).

Results and Discussion

Physico-chemical Characteristics of the Area before Sowing of Wheat Crop: The data presented in Table 1 depicts that the soil was clay loam in texture, slightly saline, deficient in nitrogen and phosphorus, but had sufficient available potassium. The pH of soil was 7.8. It was further found that the soil contained relatively low quantities of available potassium, phosphorus and total nitrogen, however, sufficient amount of Mn, Zn, Fe, Cu was found (Table 1).

Plant Height and Tiller Number: Nitrogen applied in three splits displayed greater height and number of tillers in wheat plants (Table 2). The fact may be that split application during the early growth phases improved growth pattern which resulted tall plants and more tillers as compared to two splits. The another reason may be that nitrogen is the nutrient which is not retained in the soil for long time, hence, the split nitrogen application provided the chance to plants to uptake the nitrogen during whole growth period. Similar results were reported by Yousef *et al.*, (1977); Tila Muhammad *et al.*, (1987); Chhajro (1989) and Babowicz *et al.*, (1985).

Among the sources of nitrogenous fertilizer, urea proved to be more effective fertilizer and recorded taller plants with maximum number of tillers, followed by ammonium nitrate. Whereas, ammonium sulphate resulted in minimum plant height and tillers (Table 2). The taller plants having more tillers in urea treated plots were mainly because of availability of urea in the granular form, however, ammonium nitrate or ammonium sulphate fertilizers were in the powder form. In the granular form, the nitrogen was available long time, whereas, powder form evaporated or leached down, resulting dwarf plants and less tillers. Similar results have also been reported by Babowicz *et al.*, (1985).

The interaction between method of nitrogen application and sources of nitrogenous fertilizer showed that urea applied in three splits displayed maximum plant height and tiller production, whereas when applied in two splits recorded minimum plant height and tillers as compared to ammonium nitrate and ammonium sulphate, if, applied in two or three split doses (Table 2).

Earhead Length and Seed Index (1000 grain weight): The application of urea as nitrogen recorded longer spikes and heavy grains followed by ammonium nitrate, however, the application of nitrogen as ammonium sulphate resulted in shorter spikes and lower seed index (Table 2). These results are in accordance with those of Babowicz *et al.*, (1985), who reported that urea source for nitrogen was more effective as compared to other nitrogenous fertilizers.

The interaction between methods of application and sources showed that three splits of urea gave maximum spike length and seed index, followed by two splits of urea and three splits of ammonium nitrate respectively, whereas, the interaction between two splits of ammonium sulphate had minimum spike length and seed index (Table 2). These results are in contrast to those of Chhajro (1989), who reported that split application of nitrogen produced greater seed index.

Grain and Straw Yields: Nitrogen applied in three split doses resulted in maximum grain and straw yields which were also significantly better with nitrogen applied in two split doses (Table 2). The higher yields in three split doses was mainly because nitrogen is a readily available nutrient and not retained in the soil for long time. These results are in agreement with the results reported by Yousef *et al.*, (1977); Khalilove and Mekhtieva (1978); Rathore and Singh (1980); Garcia and Torres (1981); Dubetz and Freyman (1982); Farnworth and Said (1983b); Destri-nicosia and Quitadamo (1983) all researchers reported that nitrogen fertilizer should be incorporated in the split application for achieving target straw and grain yields.

It was further found that application of urea resulted in greater grain and straw yields, followed by ammonium nitrate. Whereas, the minimum grain and straw yields were obtained in case of ammonium sulphate (Table 2). The greater grain and straw yields in urea treated plots were mainly due to the granular form of the urea fertilizer which remained in the soil and plant got chance to uptake uniformly with moisture as compared to ammonium nitrate and ammonium sulphate, both leached down due to their powder form and plant could not utilize N properly.

Table 1: Physico-chemical Characters of the Soil before Sowing of the Crop

Depth	Texture	1:5 soil water extract				Zn	Cu	Fe	Mn	N	K	P
		PH	Ec	OM%	$CaCO_3$	Mg/kg	Mg/kg	Mg/kg	Mg/kg	%	Ppm	Ppm
0-30	Clay Loam	7.8	0.34	0.90	10.24	1.4	3.0	3.10	3.10	0.038	240	8.0

Table 2: Wheat Crop Characters as Affected by Method and Source of Nitrogen Fertilizer

Tillers Per Plant

Method of Application	Sources			Mean
	Urea	Ammonium Nitrate	Ammonium Sulphate	
Two splits	4.00e	3.80c	3.45e	3.75b
Three splits	5.80a	4.85b	4.10c	4.92a
Mean	4.90a	4.33b	3.78c	
	Methods(M)		Sources(S)	MxS
SE=	0.193		0.236	0.334
LSD (5%) =	0.411		0.411	0.711
LSD(1%) =	0.569		0.696	0.986

Size of Earhead (cm)

Method of Application	Sources			Mean
	Urea	Ammonium Nitrate	Ammonium Sulphate	
Two splits	8.40	8.00	7.85	8.08
Three splits	9.10	8.30	8.00	8.47
Mean	8.75	8.15	7.93	
	Methods(M)		Sources(S)	MxS
SE=	0.065		0.080	0.113
LSD (5%) =	-		0.170	0.240
LSD (1%) =	-		0.236	0.333

Seed Index (1000 grain weight)

Method of Application	Sources			Mean
	Urea	Ammonium Nitrate	Ammonium Sulphate	
Two splits	47.92	44.80	43.95	45.56
Three splits	50.90	47.92	46.40	48.41
Mean	49.41	46.36	45.18	

	Methods(M)	Sources(S)	MxS
SE=	0.988	0.210	1.711
LSD(5%) =	2.104	2.577	3.645
LSD(1%) =	2.914	3.570	5.047

Conclusion

The results depicted that method of nitrogen application had significant effect on growth and yield contributing characters of wheat crop. Nitrogen applied in three split doses increased plant height, tiller number, size of earhead, seed index, grain and straw yields. Among the sources of nitrogen, application of urea significantly was more effective fertilizer as compared to ammonium nitrate and ammonium sulphate. It is recommended accordingly from the present investigations that for obtaining better production of wheat, the crop should be fertilized with urea applied in three split doses. The application of urea applied in three splits significantly increased grain and straw yields of wheat. This increment in wheat grain and straw was mainly due to improvement in plant height, tiller number, size of earhead and seed index respectively.

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