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EFFECT OF FERTILIZATION ON YIELD AND COMPOSITION OF SOME PROMISING WHEAT VARIETIES

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A field experiment was conducted to see the effect of nitrogen, phosphorus and potash fertilization on three recently evolved short-statured wheat varieties LU 230, LU 237 and LU 238 and two medium-statured varieties LU 227 and LU 228. Maximum yield potential of these varieties could not be realized because of toxic effect of urea on germination, tillering and severe rust attack. Generally medium statured varieties produced significantly higher grain and total dry matter yield than the short-statured ones. LU 228 with 41.76 mds. per acre closely followed by LU 227 with 41.18 mds. per acre, gave the highest grain yield. All the varieties outyielded Chenab 70. Higher nitrogen rates caused a significant decrease in grain and total dry matter yield. Combination of phosphorus with nitrogen produced significantly more total dry matter and grain yield while potash fertilization showed no response. Nitrogen fertilization improved nitrogen, phosphorus and ash contents of wheat grain. Phosphorus application along with nitrogen showed depressing effect on nitrogen percentage of wheat grain (in medium statured varieties only). However, an increase in ash and phosphorus contents was recorded with phosphorus and potash fertilization.

INTRODUCTION

High yielding varieties of wheat, responsive to heavy fertilization, can alleviate the problem of food shortage to a greater extent. Two medium-statured varieties, LU 227 and LU 228, and three short-statured varieties LU 230, LU 237 and LU 238 were evolved by the Plant Breeding and Genetics Department of University of Agriculture, Lyallpur. Since these varieties have only recently been evolved, their fertilizer needs have not been determined so far. Therefore the present study was planned to evaluate the yield and composition of these varieties under heavy nitrogen, phosphorus and potash fertilization.

Yield and composition of wheat are reported to be much affected by fertilization. Smith (1947) and Black (1970) reported some decrease in wheat yield which they attributed to excessive nitrogen application alone. Wahhab

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(1957) and Khan (1958) reported higher yields with nitrogen and phosphorus application. Wahhab and Ali (1962) stated that potash did not show any beneficial effect on yield beyond 30 lbs. K_2O per acre. They further reported that potash application increased the ash and phosphorus contents of the wheat grain. Hussain and Butt (1963) reported depressing effect of nitrogen fertilization on ash and phosphorus contents of wheat grain but nitrogen content was increased. Singh (1962) stated that nitrogen and phosphorus application increased the uptake of both nitrogen and phosphorus.

MATERIALS AND METHODS

The experiment was conducted in the Department of Soil Science, University of Agriculture, Lyallpur, on a productive sandy clay loam soil of average fertility (Table 1). Two sets of varieties were tested separately, Set 'A' consisting of medium-statured varieties LU 227, LU 228 and Chenab 70, was tested with fertilizer treatments of $N_{60}P_0$, $N_{120}P_0$, $N_{180}P_0$, $N_{60}P_{75}$, $N_{120}P_{75}$ and $N_{180}P_{75}$ (the subscripts indicate the rate of N and P_2O_5 per acre). Set 'B' comprising short-statured varieties LU 230, LU 237 and LU 238 with Chenab 70 as the standard variety, was tested under fertilizer treatments of $N_{100}P_{50}$, $N_{200}P_{50}$, $N_{300}P_{50}$, $N_{100}P_{100}$, $N_{200}P_{100}$, $N_{300}P_{100}$, and $N_{300}P_{100}K_{100}$. Nitrogen, P_2O_5 and K_2O_0 were applied as urea, triple-superphosphate and potassium sulphate, respectively. All fertilizers were applied in a single dose after mixing where required, by surface broadcast, and then mixed into the soil by cultivating once with three-tine hoe.

The experiment was laid out according to a split plot design with three replications, the varieties being randomised in main plots and fertilizer treatments in subplots. Medium- and short-statured varieties were sown on November 7 & 18, 1972, respectively by an automatic hand drill with the planted lines one foot apart. Four irrigations were applied to set 'A' and five to set 'B'. Germination and tillering were counted by random selection of two feet each from two rows in each plot, when maximum germination and tillering were attained.

Total dry matter and grain yield data from each plot were recorded and grain analysed for nitrogen, phosphorus and ash contents, respectively by Micro-Kjeldahl method of A.O.A.C. (1960), colorimetric method as given by Jackson (1960) and dry ashing method of Jackson (1960). The data were subjected to the analysis of variance and means compared by Duncan's multiple range test.

TABLE 1. Physical and Chemical Analysis of Field Soils

Mechanical Analysis

Fields	Sand %	Silt %	Clay %	Textural Class
Block No. 14	67.3	15.3	17.4	Sandy clay loam
Block No. 16	60.6	19.8	19.6	Sandy clay loam

Chemical Analysis

Fields	Depth	pH	Electrical conductivity, m. mhos/cm	Organic matter, %	Total Nitrogen, %	Available P_2O_5, ppm
Block No. 14	0—6"	8.11	2.43	0.55	0.053	11 30
	6—12"	8.10	2.28	0.51	0.050	10.85
Block No. 16	0—6"	8.00	2 13	0.67	0.056	12.25
	6—12"	8.02	2.10	0.60	0.049	11.00

RESULTS AND DISCUSSION

Effect of Various Fertilizers on Germination and Tillering

Effect of fertilization on the germination of medium statured varieties was highly significant. $N_{60}P_{75}$ treatment gave the highest germination of 51.1 plants per four feet of row (Table 2). This was followed by $N_{120}P_{75}$, $N_{180}P_{75}$ and $N_{60}P_0$ which showed similar but significantly less germination. Mean values of the germinated plants per four feet of row indicated that N_{60} gave the highest number of plants which were significantly higher than 43.3 plants in the case of N_{120}. N_{180} gave the least number of germinated plants. It was further seen that application of 75 lbs. P_2O_5 per acre gave significantly higher number of plants than no phosphorus application (Table 2).

As to the average number of tillers per four feet of row, it would be seen that in short statured varieties Ch. 70 gave significantly less number of tillers as compared to the other varieties which behaved similarly (Table 3), while in medium statured varieties LU 227 gave the highest number of tillers which were significantly higher than LU 228 and Ch. 70 (Table 2).

Data in Table 2 further indicated that the highest number of tillers was produced by $N_{60}P_{75}$ which was followed by $N_{120}P_{75}$, $N_{180}P_{75}$ and $N_{60}P_0$ giving similar but significanlty less values. The highest nitrogen

TABLE 2: Effect of Nitrogen and Phosphorus Application on some Characters of Medium Statured Wheat Varieties

Varieties & Fert. Treat.	Av. No. of germinated plants	Av. No. of tillers	Total dry matter, md /acre	Grain yield, md./acre	Nitrogen %	Phosphorus %	Ash %
LU 227	44.8 a	175.4 a	126.10 a	41.18 a	2.329 a	0.332 a	1.701 a
LU 228	40.4 a	140.6 b	116.78 a	41.76 a	2.242 a	0.330 a	1.606 b
Ch. 70	46.7 a	132.4 b	98.35 b	29.42 b	2.368 a	0.336 a	1.640 ab
$N_{60}P_0$	45.2 bc	49.6 c	101.56 c	34.10 c	2.254 c	0.306 c	1.573 d
$N_{120}P_0$	41.2 cd	134.2 d	96.61 c	31.53 c	2.344 b	0.327 d	1.615 c
$N_{180}P_0$	37.6 d	116.4 e	96.43 c	31.35 c	2.395 a	0.336 c	1.649 c
$N_{60}P_{75}$	51.1 a	180.2 a	134.93 a	45.22 a	2.251 c	0.335 c	1.641 c
$N_{120}P_{75}$	45.5 b	166.6 b	129.02 b	42.75 a	2.282 c	0.343 b	1.684 b
$N_{180}P_{75}$	43.1 bc	149.2 c	123.91 b	39.69 b	2.351 b	0.348 a	1.734 a
N_{60}	48.1 a	164.9 a	118.25 a	39.66 a	2.253 c	0.323 c	1.607 c
N_{120}	43.3 b	150.1 b	112.72 b	37.20 b	2.313 b	0.335 b	1.649 b
N_{180}	40.3 c	132.8 c	110.26 b	35.52 b	2.373 a	0.342 a	1.692 a
P_0	41.3 b	133.4 b	98.20 b	32.32 b	2.331 a	0.323 b	1.612 b
P_{75}	46.6 a	165.4 a	129.28 a	42.50 a	2.295 b	0.341 a	1.686 a

Note : Averages followed by the same letter are statistically alike at the 5% probability level.

rate without phosphorus ($N_{180}P_0$) gave the least number of tillers. Seventy five lbs. P_2O_5 application induced significantly higher tillering. In the case of short statured varieties, N_{100}, N_{200} and N_{300} each with 100 lbs. P_2O_5 per acre and $N_{300}P_{100}K_{100}$ gave similar but significantly higher number of tillers than rest of the treatments (Table 3).

As explained by Court *et al* (1964) the depressive effects of higher nitrogen rates without phosphorus application on germination and tillering may be attributable to the toxic effects of urea caused by the accumulation of ammonia and nitrite during nitrification of urea. This was probably aggravated by improper mixing which was done by the three tined hoe after the broadcast of fertilizers. Phosphorus application along with nitrogen improved germination and tillering. Similar results were obtained by Stephen and Waid (1963) who reported that adverse effect of ammonia released from urea could be lessened by H^+ releasing phosphate fertilizers.

Effect of Various Fertilizers on Grain and Total Dry Matter Yield.

Maximum yield potential of varieties could not be realised due to deleterious effect of urea and severe rust attack during the crop season. An overall view of the data on grain and total dry matter yield in Tables 2 and 3 indicated that medium statured varieties produced more grain and total dry matter yield than short statured ones. This may be due to smaller number of ear bearing fillers and lighter shrivelled grains probably caused by heavier rust attack in the case of short statured varieties. Maxium total dry matter and grain yield were recorded in the case of LU 227 and LU 228. In both the sets, Chenab 70 gave significantly lower yield.

Higher nitrogen rates resulted in a decrease of grain and total dry matter yield apparantly attributable to a decreased germination, tillering and higher rust attack (Tables 2 and 3). Similar results were reported by Smith (1947) and Black (1970) which they explained due to excessive nitrogen application alone. The data conclusively revealed that higher phosphorus rates improved the yielding effectiveness of nitrogen application especially with N_{60} and N_{120} in medium statured varieties and N_{100} and N_{200} in short statured varieties. $N_{60}P_{75}$ and $N_{100}P_{100}$ gave maximum grain and total dry matter yields. Potash inclusion in a treatment showed no positive response. Wahhab and Ali (1962) and Khan (1968) reported similar results.

Effect of Various Fertilizers on Composition of Wheat Grain.

Differences in nitrogen, phosphorus and ash contents of grain were non-significant in both sets of medium and short statured varieties (Tables 2

TABLE 3. Effect of Nitrogen, Phosphorus and Potash Application on some Characters of Short Statured Wheat Varieties.

Varieties & Fert. Treat	Av. No. of tillers	Total dry matter mds/acre	Grain yield mds/acre	Nitrogen %	Phosphorus %	Ash %
LU 230	204.00 a	95.49 b	25.98 ab	2.449 a	0.327 a	1.584 a
LU 237	203.00 a	107.22 a	29.39 a	2.308 a	0.327 a	1.578 a
LU 238	198.00 a	93.60 b	23.12 b	2.468 a	0.329 a	1.543 a
Ch. 70	145.00 b	88.54 b	22.94 b	2.391 a	0.328 a	1.566 a
$N_{100}P_{50}$	184.00 b	98.91 b	28.42 a	2.256 c	0.311 f	1.501 c
$N_{200}P_{50}$	177.00 b c	92.68 cd	24.10 c	2.421 b	0.318 e	1.516 dc
$N_{300}P_{50}$	169.00 c	87.12 d	23.24 c	2.456 ab	0.325 d	1.539 d
$N_{100}P_{100}$	198.00 a	106.62 a	29.50 a	2.310 c	0.326 d	1.580 c
$N_{200}P_{100}$	198.00 a	98.91 b	25.94 b	2.436 ab	0.332 c	1.595 bc
$N_{300}P_{100}$	195.00 a	96.89 bc	23.94 c	2.472 ab	0.338 b	1.608 b
$N_{300}P_{100}K_{100}$	194.00 a	93.02 cd	23.14 c	2.480 a	0.344 a	1.633 a

Note : Averages followed by the same letter are statistically alike at the 5% level of probability.

and 3). However, among medium statured varieties, ash content of LU 227 was significantly higher than LU 228. Higher nitrogen rates caused an increase in nitrogen, phosphorus and ash percentages of grain which may be due to their higher concentration caused by heavy reduction in grain and total dry matter yield. Asif and Larson (1962) and Hussain and Butt (1963) reported depressing effect of nitrogen fertilization on ash and phosphorus contents of wheat grain. They attributed their results of decreased ash and phosphorus contents by nitrogen fertilization due to growth dilution effect. Nitrogen percentage of grain of medium statured varieties was significantly reduced with phosphorus fertilization (Table 2), however, non-significant increase of nitrogen percentages was observed with higher phosphorus level at all nitrogen rates except N_{100} where increase in the case of short statured varieties was significant (Table 3). Ash and phosphorus contents were also increased with increasing phosphorus rates. Singh (1962) and Asif and Larson (1962) obtained higher nitrogen and ash contents of grain by application of phosphorus in combination with nitrogen.

N P K treatment was found superior to all the other treatments with regard to nitrogen, phosphorus and ash contents of wheat grain (Table 3). Khan (1968) and Wahhab and Ali (1962) reported similar results.

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