Research Article

Ameliorating effect of Nitrogen and Sulfur on quality of different corn hybrids

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Abstract

A two years field trial was carried out at New Developmental Farm (NDF), the University of Agriculture Peshawar to find out the AMELIORATIVE effect of nitrogen (N) and sulfur (S) on quality of different maize hybrids. Inorganic N was applied @ 0, 250, 300 and 350 kg ha⁻¹, whereas S was applied @ 0, 20, 40 and 60 kg ha⁻¹. Both N and S were kept in main plots. Maize hybrids used were R-3305, R-2210 and R-2207 respectively, allotted to sub-plots. S levels had non-significant effect on protein (%), whereas oil (%) was significantly affected and maximum oil (6.22%) was found in plots receiving maximum level of S (60 kg ha⁻¹). N levels had opposite effect on these quality parameters as protein significantly affected, and maximum protein (11.91%) was found in plots with maximum level of N (350 kg ha⁻¹). Among hybrids R-2210 was found with maximum oil (5.64 %) and maximum protein (10.44 %), as compare to other two hybrids i.e. R-3305 and R-2207. Years had significant effect on protein as compare to oil (%). Hence N and S can play a significant role in improving the quality of corn hybrids and can be manipulated according to the needs of the farmer and situation.

Key words: Quality of maize kernel, corn hybrids, Inorganic fertilizer.

Introduction

Worldwide the demand for oil from plant source both for food and other industrial uses has increased tremendously and globally from health perspective plant protein and oil use expanded. Moreover, Pakistan in comparison to other agro based countries of the subcontinent is facing a severe shortage of edible oil as the gap between production and consumption level has increased. Consequently a major share of foreign exchange is spent on oil imports, which is increasing every year [1].

Maize (*Zea mays* L.) has gained popularity among cereal crops among the farming and business community because it is the most efficient and productive cereal crop. Moreover it ranks 3rd in Pakistan in terms of production when compared with rice

and wheat. About 70% of maize is used for animal feed and remaining for industrial products [2]. Maize is a major source of raw materials for the industrial production of various goods such as corn starch, corn oil, cosmetics, wax and alcohol. Chemical composition of maize includes having 72% starch, 10% protein, 8.5% fiber and 1.7% ash [3].

Nitrogen is the basic part of amino acids and hence building blocks of protein, which regulates plant growth and makes up 1 to 4% of dry matter of the plants [4]. Since nitrogen (N) is a component of protein and nucleic acids and when N is below the optimum level, plant growth and development is reduced [5]. Similarly sulfur (S) is also considered as the 4th major important nutrient after three primary macronutrients (N, P and K), and

it has been observed that on an average maize crop absorbs S equally as phosphorous (P). Moreover full yield potential of the crop depends on S availability in the soil regardless of the presence of other nutrients [6]. S containing amino acids are the best indicators of determining the quality of maize grain particularly and other cereals as well [7]. Keeping in view the above mentioned facts a research study was carried out to know the role of N and S in improving the quality *viz.*, Protein and oil of different corn hybrids in Peshawar.

Materials and Methods

Experiment description

An experiment entitled “effect of nitrogen and sulfur in improving the quality of corn hybrids” was carried out in the NDF (New developmental farm) in the University of Agriculture Peshawar during 2013 and 2014. The experiment was designed in RCB (Randomized complete block) arranged in split plot replicated thrice. N and S was used in main plots as nutrients @ 0, 250, 300, and 350 kg N ha⁻¹, and 0, 20, 40, and 60 kg S ha⁻¹, whereas maize hybrids (H) *viz.*, R-3305, R-2210, R-2207 and seed @ 40 kg ha⁻¹ were allotted to subplots.

Agronomic description

Maize hybrids were sown on ridges and sowing was done in 1st week of March in both seasons, with row to row distance of 75 cm and plant to plant distance of 25 cm, and subplot size was 3.50 x 3.75 m² in order to maintain a plant population of 67333 plants ha⁻¹. The field was irrigated when needed and all other agronomic practices were carried out uniformly for all experimental units.

Nutrient management

N and S were used as main plot factors and applied per treatments whereas phosphorous (P) and potassium (K) was applied @ 120 and 100 kg ha⁻¹ uniformly for the whole experimental plot, applied at sowing time. Ammonium sulphate and Urea were used for N and S, and in plots where 0 kg ha⁻¹ of N was used, then

elemental sulfur (97% S) was applied. The N was applied in split doses, in seedling stage, at knee stage and at boot stage, whereas sulfur was applied all in sowing time.

Parameters studied

Date was recorded on the following parameters.

Protein (%)

Oil (%)

The grain protein content was determined through Bradford method for total protein quantification [8]. For fat determination in the maize grain, Soxhlet method for extraction of oil was used [9].

Statistical analysis

Data analyzed according to ANOVA technique appropriate for randomized complete block (RCB) design with split plot arrangement using Statistix 8.1 software. The treatment means were compared at $P < 0.05$ level of probability using LSD test [10].

Results and Discussion

Protein (%)

Statistical analysis of the data revealed that nitrogen levels, maize hybrids and years had significant effect on protein (%), whereas sulfur had no significant effect. Mean values for nitrogen levels showed (Table 1) that maximum protein (11.91%) was observed in treatments with N level of 350 kg ha⁻¹ and minimum protein (%) were recorded in control plots (9.01%). This could be due to the fact that N is the main part of amino acids, and amino acid is the building block of protein and hence N significantly affects protein contents. It has been found in field experiments that N application improved protein content of maize grain pea [11, 12]. R-2210 was reported with maximum protein (10.44%), followed by R-2207 (10.06 %) and then R-3305 (9.83%). This could be due to the genetic characteristics of maize hybrids which responded differently to N levels and in turn produced statistically different protein content of maize grain. N x H was found significant as shown in Fig. 1 [13].

Table-1. Protein and oil (%) of different corn hybrids as affected by nitrogen and sulfur.

Sulfur (kg ha ⁻¹)	Protein (%)			Oil (%)		
	2013	2014	Mean	2013	2014	Mean
0	9.88	10.36	10.12	4.64 d	4.70 d	4.67 d
20	9.81	10.43	10.12	5.15 c	5.18 c	5.16 c
40	9.74	10.53	10.14	5.93 b	5.95 b	5.94 b
60	9.75	10.35	10.05	6.23 a	6.22 a	6.22 a
LSD _(0.05)	ns	ns	Ns	0.015	0.019	0.008
Nitrogen (kg ha ⁻¹)						
0	8.69 d	9.32 d	9.01 d	5.45	5.47	5.46
250	9.22 c	10.05 c	9.63 c	5.54	5.55	5.54
300	9.67 b	10.10 b	9.88 b	5.49	5.53	5.51
350	11.60 a	12.21 a	11.91 a	5.47	5.50	5.48
LSD _(0.05)	0.03	0.03	0.01	ns	ns	ns
Hybrids						
R-3305	9.51 c	10.15 c	9.83 c	5.41 c	5.45 c	5.43 b
R-2210	10.15 a	10.73 a	10.44 a	5.62 a	5.65 a	5.64 a
R-2207	9.73 b	10.39 b	10.06 b	5.44 b	5.43 b	5.43 b
LSD _(0.05)	0.02	0.02	0.01	0.009	0.011	0.005
Mean	9.79 a	10.42 b		5.49	5.51	
Interaction						
S x N	Ns	ns	Ns	*	*	**
S x H	Ns	ns	Ns	**	**	**
N x H	**	**	**	ns	ns	ns
S x N x H	ns	ns	Ns	ns	ns	ns
	Mean effect for Protein (%)			Mean effect for oil (%)		
Y x S	ns			ns		
Y x N	*			ns		
Y x S x N	ns			ns		
Y x H	ns			ns		
Y x S x H	Ns			ns		
Y x N x H	Ns			ns		
Y x S x N x H	Ns			ns		

Means followed by different letters are significantly different from each other at 5% level of probability.

* = Significant at 5% level of probability.

** = Significant at 1% level of probability.

ns = Non-significant.

Fig 1. Protein (%) of different corn hybrids as affected by nitrogen and hybrids

Fig 2. Oil (%) of different corn hybrids as affected by nitrogen and sulfur

Fig 3. Oil (%) of different corn hybrids as affected by sulfur and maize hybrids

Oil (%)

Data regarding oil (%) indicated that S and maize hybrids had significant effect on oil (%), whereas nitrogen and years had non-significant effect. Mean values for S revealed that maximum oil (%) were found in treatments with S level of 60 kg ha⁻¹ i.e. 6.22, while minimum oil of 4.67% was found in control plots. The probable reason for this could be that S being a major part of unsaturated fatty acids and hence affected the oil content of maize grain. R-2210 produced grains with maximum oil (5.64 %), while the other two hybrids produced statistically similar oil (5.43%), which could possibly be due to genetic characteristics of hybrids [14]. S x N and S x H were significant as shown in Fig. 2 and Fig. 3, respectively.

Conclusively N and S plays a very significant role in improving the quality of the maize grain in terms of protein and oil. As N levels linearly enhanced protein level and S levels also affected the oil (%) of maize kernel. Moreover maize hybrids due to their different genetic makeup responded accordingly to both nutrients. Hence more research work is needed to find out the best nutritional combination of N and S.

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