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INFLUENCE OF NITROGEN AND SULFUR ON WEEDS DENSITY AND PHENOLOGY OF WHEAT AND TRITICALE

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ABSTRACT

Crop productivity is highly emphasized by effective crop stand and efficient weeds control management. Commercial fertilization has gained supreme importance in Pakistani cropping system because of the increasing demand of food day by day. Fertilizer management is the key in the prevailing conditions. The study titled "Influence of nitrogen and sulfur on phenology and weeds density of wheat and triticale" was therefore laid out at the Agronomy Research Farm of the University of Agriculture, Peshawer, Pakistan during 2014 in a randomized complete block design with three replications. The trial consisted of three levels of nitrogen and sulfur with two crop species (wheat and triticale) and a control for each crop species. The data was recorded on days to booting, heading, anthesis, maturity and weeds density m^{-2}. The results showed that the higher levels of both the fertilizers 120 kg N ha^{-1} and 45 kg S ha^{-1} delayed booting, heading, anthesis and maturity of both the crops. Triticale was earlier to reach booting, heading and anthesis stage but was found late to obtain maturity. Similarly weeds density positively responded to the increasing rate of both fertilizers. Wheat crop recorded more weeds density as compared to triticale. Based on the experimental facts 120 kg N ha^{-1} and 30 kg S ha^{-1} is recommended for valuable crop stand and effective weed management.

Key words: Nitrogen, phenology, sulfur, triticale, weeds density.

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INTRODUCTION

Wheat (*Triticum aestivum* L.) ranks first among all the cereals in the world regarding the area allocation and production. It is a *rabi*

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annual, self-pollinated and require long days for fertilization. Wheat is the most widely and largely grown crop of the world and is considered to be an important staple food. Increasing population of the world and the dependence of large population on this food crop requires much more wheat to be produced (Rana *et al*., 2013a). Moreover, wheat is an exhaustive crop which not only reduces soil fertility but also degrades the soil chemical and physical properties. Wheat crop depletes NPK by 227 kg ha^{-1} (Kharub and Sharma, 2002). Therefore it is required to ensure the latest production technologies and the use of adequate amount of inputs.

Triticale (*Tritico secale* Wittmack) is a manmade cereal species that is the product of the cross of rye and wheat. Recently engineered cultivars of triticale show potential for higher yield and tremendous adaptation to almost all type of soils and can survive in harsh environments as compared to wheat. Modern cultivars of triticale are rich in proteins that thus indicate its future use as human foods (Estrada-Campuzano *et al.*, 2012). Triticale flour may be considered as the ultimate substitute for wheat in case of wheat shortage (Pena and Amaya, 1992).

Nitrogen is a key supplement that plays an important role in enhancing soil fertility and crop productivity (Habtegebrial *et al*., 2007). Nitrogen has got supreme importance regarding plant metabolism and other biochemical process. Nitrogen fertilization affects almost all the yield components of all the crops (Estrada-Campuzano *et al*., 2008; Lestingi *et al*., 2010; Pecio, 2010).

Sulfur is an important nutrient for effective crop yield and production. Sulfur importance, necessity and role in crop production is highly recommended (Jamal *et al*., 2010; Scherer, 2009). Similar to nitrogen, sulfur has an important role in protein synthesis, formation of amino acids, chlorophyll formation and oil content of the seeds (Jamal *et al*., 2009).

Cereal yield has been reported to be effected by a number of factors. Weeds infestation is one of them which depletes nutrients and compete for water, sunlight and space (Ali *et al.,* 2011). The competition of weeds for resources is very serious at the initial stages that cause to reduce yield later on (Mitchell *et al*., 2005). It has been reported that 25-30 % yield of wheat can be reduced by weeds (Nayyar *et al*., 1994). Weeds control mechanism is far most important to obtain effective crop stand and for achieving higher yields. Poor weeds management also alters water and fertilizer use efficiency (Tolessa and Friesen, 2001). Non judicious use fertilization also enhances weeds density and ultimately reduces yields (Blackshaw *et al.,* 2003). The present study was therefore, designed to evaluate the optimum amount of nitrogen and sulfur fertilizers for efficient growth and weeds control.

MATERIALS AND METHODS

The trial was laid out at Agronomy Research farm of the University of Agriculture Peshawer during fall 2014. The experiment comprised of three levels of nitrogen (80, 120 and 160 kg ha^{-1}), three levels of sulfur (15, 30 and 45 kg ha^{-1}) and two crop species (wheat and triticale).a control for each crop was also taken in consideration. Nitrogen was applied half at sowing and the remaining half was applied before first irrigation. All of the sulfur was applied at sowing. Urea and ammonium sulphate was used as nitrogen and sulfur sources. Phosphorous was incorporated according to recommended dose all at sowing using DAP source.

The experiment was laid out in randomized complete block design with three replications. The subplot area was maintained as 1.8m x 3m with six rows in each plot. The field was ploughed twice for making soft seed bed. 120 kg ha^{-1} seed rate was used for both the crop species. Recommended irrigation schedule was followed.

Treatment structure was as follows; wheat and triticale each was supplied nitrogen plus sulfur as 80+ 15, 80+30, 80+45, 120+15, 120+30, 120+45, 160+15, 160+30, 160+45 kg ha^{-1}.

The data on days to booting was recorded from the date of sowing till the date when 80 % of the plants completed heading stage. Number of days to heading was counted from the sowing date until 80 % plant secure headings. Days to anthesis was recorded when 80 % of the plants in each plot completed anthesis stage, similarly, total number of days to maturity was recorded until 80 % got mature in each subplot. Weeds density was recorded by counting number of weeds in one meter length at three different places in each treatment. The data was then averaged and converted to density m^{-2}.

Statistical analysis

The collected was statistically analysed with the reference of the design used. Least significant difference (LSD) test was used when F-test was found significant for means comparison (Jan *et al.,* 2009).

RESULTS AND DISCUSSION

Days to booting

Data regarding days to booting as effected by nitrogen, sulfur and crop species is stated in Table-1. Statistical analysis of the data revealed that nitrogen, sulfur and crop species significantly affected days to booting. All the interactions were found non significant. Both the factors showed linear trend by increasing the levels from low to high. Highest number of days (114) to booting was recorded from 160 kg ha^{-1} nitrogen which was in line (114) with 120 kg ha^{-1} nitrogen supplied plots. Minimum days (113) were counted from plots applied with 80 kg ha^{-1} nitrogen. Mean values for sulfur indicated highest number of days (15) when 45kg ha^{-1} sulfur was applied as compared to (114) days where 30 kg ha^{-1} sulfur was applied, (113) days were recorded from plots where lowest level of sulfur was applied 15 kg ha^{-1}. The positive effect of nitrogen and sulfur on days to booting may be because of their role in promoting vegetative growth increasing leaf area, number of leaves enhancing photosynthetic efficiency and improving translocation of photosynthates. Triticale was earlier to reach to booting (112 days) as compared to wheat (114 days). The possible reason for varied days to booting may be genetic difference of the species (Shahzad *et al.,* 2002).

Days to heading

Number of days to heading was influenced by the addition of nitrogen and sulfur. Crop species also significantly affected days to heading. All the interactions were non significant except C x S (Table-1). Control plots took less days to heading as compared to treated plots. More number of days to heading (126) were observed from 160 kg ha^{-1} nitrogen, followed by (124) recoded from 120 kg ha^{-1} nitrogen. Regarding sulfur 45 kg ha^{-1} sulfur resulted in highest number of days (125) followed by (124) days induced by 30 kg ha^{-1} sulfured plots. This might happen due to more vegetative growth resulted from efficient absorption and uptake of urea and sulfur. More rainfall during this stage also made unfavorable conditions for flower initiation which delayed heading. Wheat took longer to reach to heading stage (126 days) then triticale that took (121) days. This difference in days to heading might be due to varied reaction of cultivars to nitrogen and sulfur application or it could be inducted by variation in inherent characters of both the cultivars. These results confirm the findings of Hamid and Sarwar (2000) who reported that nitrogen and sulfur fertilization @ of 120 and 30 kg ha^{-1} respectively increase days to flower initiation in various wheat cultivars.

Days to anthesis

Table-2 shows significant ($p<0.05$) effect on days to anthesis, observed due to the differential use of nitrogen. Crop species also showed significant effect. All the interactions were non significant. Equal numbers (134) of days to anthesis were recorded from plots where 160 kg ha^{-1} and 120 kg ha^{-1} nitrogen was applied respectively. Minimum days (133) were counted from 80 kg ha^{-1} nitrogen supplied plots. Nitrogen adds to vegetative growth and improves availability of soil nitrogen. Luo *et al*. (2003) also found that nitrogen delayed tillering and anthesis in wheat. The possible reason for non significant effect of sulfur may be due to low fertility and less availability of sulfur.

Wheat took longer (135 days) to anthesis as compared to triticale (131) days.

Days to maturity

The statistical analysis the data indicates that nitrogen, sulfur and crop species had significant effect on days to maturity (Table-2). The interaction between N x S, C x Cr and C x S were significant, while the rest were found non significant. Control plots took fewer days then the treated plots. Mean values for nitrogen suggested that a linear increase in days to maturity occur as nitrogen levels increases from 80 kg ha^{-1} to 160 kg ha^{-1}. More days (162) were counted from plots where 160 kg ha^{-1} nitrogen was applied. It was followed by the plots applied with 120 kg ha^{-1} nitrogen (161). These findings are in line with those of Iqtidar *et al*. (2006) and Ayoub *et al*. (1994) who reported that nitrogen supplements enhanced vegetative growth, delayed leaf senescence and prolonged grains filling duration due to which maturity was delayed. Highest number of days (162) to maturity was recorded from plots where 45 kg ha^{-1} sulfur was applied which was statistically at par with 30 kg $ha^{-1}$and 15 kg ha^{-1} sulfur amended plots (161). Triticale took longer to reach physiological maturity by taking (161) days as compared to wheat (158). This may be due to genetic variation between the two species and the efficiency of the crop towards nitrogen and sulfur fertilization.

Weeds Density m^{-2}

Influence of nitrogen, sulfur and crop species on weeds density is presented in Table-2. Statistical perusal of the data attributed that nitrogen, sulfur and crop species significantly affected weeds density. All the interactions were found non significant accept N x S application of nitrogen resulted in linear increase in number of weeds m^{-2}. Higher number of weeds population (210) was recorded in plots treated with 160 kg ha^{-1}. It was followed by 120 kg N ha^{-1} applied plots. The possible reason for increase in weeds density with each increment in nitrogen dose may be due to the positive effect of nitrogen on germination and effective stand of weed; also most of the weeds are suggested to be efficient nitrogen users. The results are in line with those found by Blackshaw *et al*. (2003) who reported that weeds density increase with increase in nitrogen concentration. Using 45 kg S ha^{-1} produced higher number of weeds which were statistically similar with those recorded from 30 kg S ha^{-1}. This may be due to the synergistic effect of sulfur on nitrogen which increase nitrogen uptake, resulted in higher weeds density. Regarding crop species higher numbers of weeds were counted in plots where wheat was grown as compared to triticale. This may be due to differential response of genotype that effect weeds infestation of different crops. Similarly different crops have superior weeds suppressing ability and improved weeds tolerance (Javaid *et al.,* 2007; Linquist and Kropff, 1996).

Table-1. Days to booting and heading of wheat and triticale as affected by nitrogen and sulfur levels.

Nitrogen (N) (kg ha^{-1})	Days to booting	Days to heading
80	112 b	123 c
120	114 a	124 b
160	114 a	126 a
L.S D (0.05)	**	**
Sulfur (S) (kg ha^{-1})		
15	113 b	123 c
30	114 ab	124 b
45	115 a	125 a
L.S.D (0.05)	*	*
Crop species (C)		
Wheat	114 a	126 a
Triticale	112 b	121 b
L.S.D (0.05)	**	**
Control vs Rest (Cnt vs R)		
Control	112	122
Rest	114	124
Significance Level	*	**
Interactions		
N x S	ns	ns
C x Cnt vs R	ns	ns
N x C	ns	ns
S x C	ns	*(Fig 1)
N x S x C	ns	ns

Means of the same category followed by different letter are significantly different from one another at 5% and 1% level of probability.
*, ** = Significant at 5 and 1% level of probability, respectively.
Ns = non significant

Table-2. Days to anthesis, maturity of wheat and triticale, and weed density m^{-2} as affected by nitrogen and sulfur levels.

Nitrogen (kg ha^{-1})	Days to anthesis	Days to maturity	Weed density m^{-2}
80	133 b	160 c	160 c
120	134 a	161 b	189 b
160	134 a	162 a	210 a
L.S .D (0.05)	**	**	**
Sulfur (kg ha^{-1})			
15	133	161 b	157 b
30	133	161 b	171 a
45	133	162 a	180 a
L.S .D (0.05)	22.61	**	**
Crop Species (C)			
Wheat	135 a	158 b	192 a
Triticale	131 b	161 a	145 b
L.S D (0.05)	**	**	**
Control vs Rest (Cnt vs R)			
Control	132	159	132 b
Rest	133	161	173 a
L.S. D (0.05)	*	**	**
Interactions			
N x S	Ns	Ns	**
C x Cont vs R	Ns	**	Ns
N x C	Ns	Ns	Ns
S x C	Ns	*(Fig 2)	ns
N x S x C	Ns	Ns	Ns

Means of the same category followed by different letters are significantly different from one another at 5% or 1% level of probability.
*, ** = Significant at 5 and 1% level of probability, respectively.
ns = non significant.

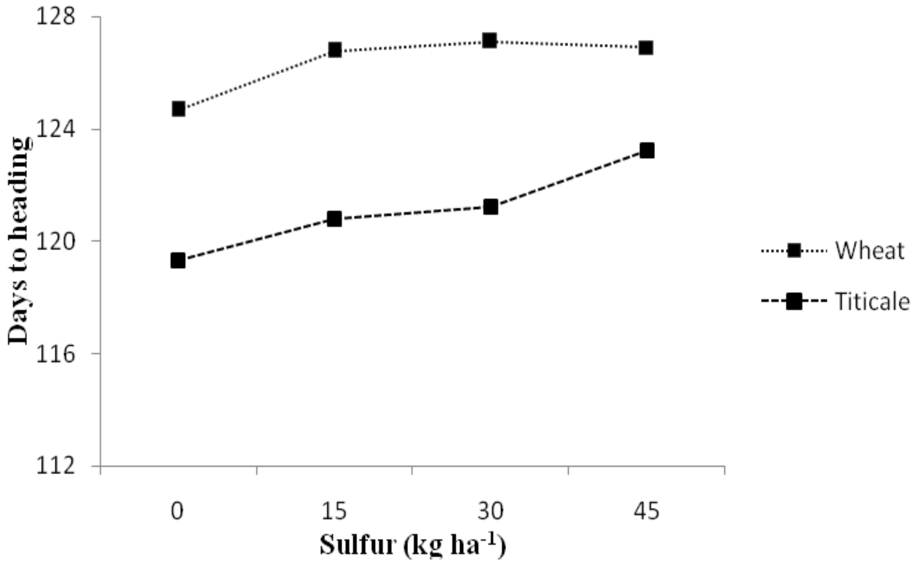

Figure 1. Interaction of sulfur and crop species for days to heading of wheat and triticale

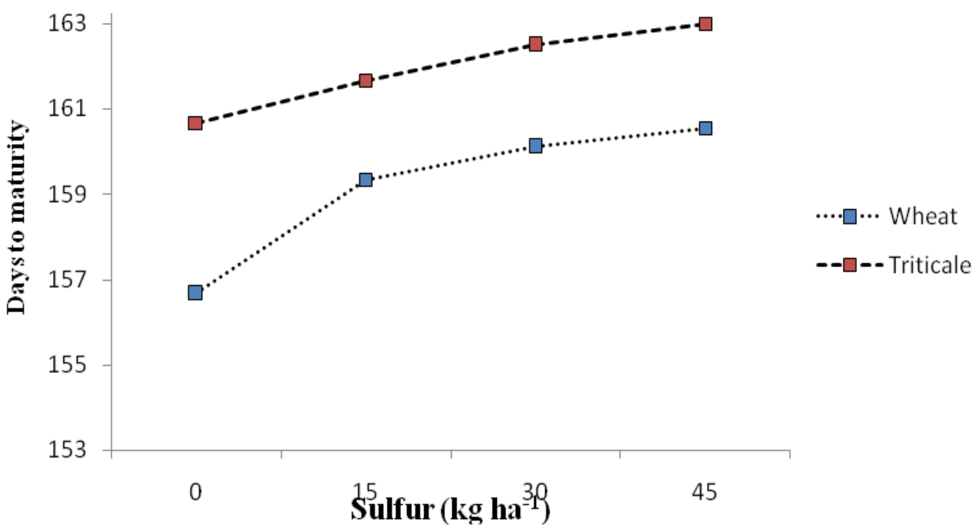

Figure 2. Interaction of sulfur and crop species for days to maturity of wheat and triticale

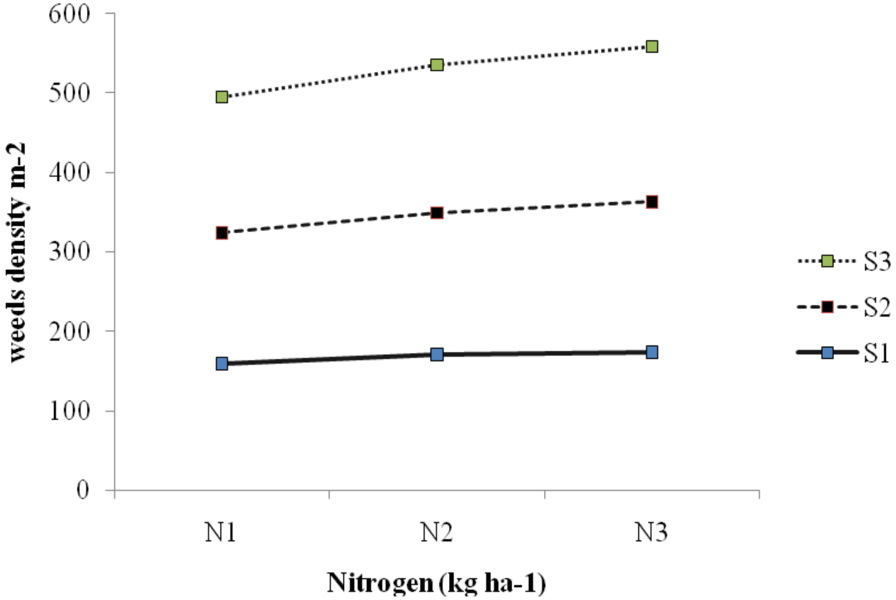

Figure 3. Interaction of nitrogen and sulfur for weeds density m^{-2} of wheat and triticale

CONCLUSION

It is concluded from the study that the highest levels of both the fertilizers (nitrogen and sulfur) at the rate of 160 and 45 kg ha^{-1} delayed penology of both the crops and enhanced weeds density m^{-2}.

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