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GROWTH DYNAMICS OF MAIZE (*ZEA MAYS* L.) AND WEEDS IN RESPONSE TO DIFFERENT NITROGEN LEVELS AND WEEDING INTERVALS

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Abstract

Maize yield is very low in Khyber Pakhtunkhwa compared to Punjab-Pakistan and advance countries of the world. Weed and improper nutrients is one of the reason for low yield. Field study was carried out for the management of weeds and nutrients (Nitrogen) in 2014 and was repeated in 2015. An open pollinated maize variety "Azam" was used in the experiment. Four nitrogen levels (N_0=0, N_1=100, N_2=150, and N_3=200 kg ha^{-1}) and seven weed periods (W_0=Weed free throughout season, W_1=15 DAS (days after sowing), W_2=30 DAS, W_3=45 DAS, W_4=60 DAS W_5=75 DAS, W_6= weed allowed for whole period). In all sub plots weeds competed with maize for the above mentioned days and were then kept free for the rest of duration through regular hand weeding. Experimental data illustrated highest plant height (220 cm), grain yield (6268 kg ha^{-1}) and biological yield (10189 kg ha^{-1}) from the plots treated with N @ 200 kg ha^{-1}. Furthermore, plots which were kept weed infested throughout the season caused severe yield losses to maize crop. However, weed competition beyond 60 days after sowing caused no significant reduction in yield. So it is recommended that weeding should be done before 30 days after sowing having nitrogen @ 200 kg ha^{-1} for enhancing grain yield in maize crop.

Key words: Maize, Nitrogen levels, Weeding intervals, Weed competition, Yield.

Introduction

Maize (*Zea mays* L.) yield is very low in Khyber Pakhtunkhwa than Punjab province of Pakistan (Anon., 2015). Similarly maize average yield is also low than advanced countries due to many factors. However, the important one is weed competition (Najafi and Tollenaar, 2005). Weeds compete for sunlight, fertilizer and water etc. and may reduce crop quality and quantity. Weeds are serious threat for both irrigated and rain fed areas. Yield losses due to weeds in maize ranged from 20-40% (Saeed *et al*., 2016: Saeed *et al*., 2012; Ashique *et al*., 1997), while in some cases it might cause 25-80% yield reduction (Chikoye and Ekeleme, 2003). A broad spectrum of broadleaved as well as grassy weeds infested maize fields. The common weeds found in maize crop are *Convolvulus arvensis, Amaranthus viridis, Cyperus rotundus, Cynodon dactylon, Portulaca olereacea, Echinochloa crus-galli, Digitaria sanguinalis, Leptochloa* sp. and *Sorghum halepense* (Abdullah *et al*., 2008; Mousavi, 2001).

Nitrogen improve the quality of maize grain by increasing protein content (Amanullah *et al*., 2009). Nitrogen determines the yield formation and crop size (Arnold *et al*., 1974; Subedi and Ma, 2009; Bruns & Ebelhar, 2006; Overman & Brock, 2003). Due to low level of soil organic matter and leaching of soil nutrients, nitrogen is mostly deficient in soil and ultimately decrease production. In both weed and maize soil nitrogen requirement is high thus competition between maize and weed for available nitrogen further increased the nitrogen problem. Different nitrogen applications may affect the growth of maize and weeds (Matloob *et al*., 2015).

Materials and Methods

The trail was conducted in summer 2014 and was repeated on same piece of land in 2015, at Agricultural University Peshawar-Pakistan. There were no significant differences between both years, thus the data of both years for all the parameters were averaged before the analysis. Maize variety "Azam" was used in the experimental trail. Different nitrogen levels viz., N0=0, N_1=100, N_2=150, and N_3=200 kg ha^{-1} (main plot) weed periods i.e. W_1= weed free throughout season W_1=15 (DAS), W_2=30 (DAS), W_3=45 (DAS), W_4=60 (DAS) W_5=75 (DAS), and W_6= weed allowed to grow for whole period (sub plots). In sub plots (W_1 to W_5 treatments) first weeding was done after the above mentioned days after sowing and was then kept weed free throughout season by regular hand weeding. The data were analyzed by SPSS v.20 software.

Results and Discussions

Weed density (m^{-2}): Significant results were obtained for weed density in table 1. Highest weed density (148.7m^{-2}) were noticed in 200 kg ha^{-1} N level treatment however, it was statistically at par to all other nitrogen levels except zero level (Table 2).

Moreover, highest weed density (93.2 m^{-2}) were observed zero N plots. The reason for high weed density in nitrogen used treatments might be due to availability of more nitrogen to weeds as compared to zero nitrogen level treatments. Amanullah *et al*., 2014 and Jalali *et al*., 2012, reported that high nitrogen level treatments lead to high weed density. In another study lack *et al*., 2011 also concluded that nitrogen level and weed density are directly proportional to each other.

Maximum weed density of 186.8 m^{-2} were observed in plots where weeds were not harvested for entire period, while low weed density (129.7 m^{-2}) were recorded in those plots where weeding was done 15 days after sowing (DAS). In weed free treatments the weed density was zero because there was regular weeding throughout the season. The results showed that weed density was gradually increased with increase in weeding intervals.

The interaction data also showed significant results for weeding intervals and nitrogen levels. The R^2 values at various nitrogen levels i.e. N_0, N_1, N_2 and N_3 were 95, 97, 96 and 99 %, respectively. The trend lines showed that there was a gradual decreased in weed density with increased in weeding periods (Fig. 1).

According to Maqbool *et al*., (2006) increased in weeding intervals leads to increased in weed density. The results were similar to El-Bially, (1995) who reported that an increase in weeding intervals resulted in high weed density.

Thousand grain weight (g): Statistical analysis of the data revealed significant differences for thousand grain weight with non-significant interaction. The data showed that highest thousand grain weight in 200 kg ha^{-1} nitrogen level treatments (563.2 g) followed by 100 and 150 kg ha^{-1} (452.3 g and 504.4 g). However lowest thousand grain weight was observed in zero nitrogen level treatment (286.1 g). The maximum nitrogen resulted in maximum dry matter accumulation. Increased in nitrogen might enhance photosynthesis that ultimately resulted in maximum grain weight (Matloob *et al*., 2105; Rashidi *et al*., 2105; Akram *et al*., 2010; Inamullah *et al*., 2011; Akram *et al*., 2010; Saeed *et al*., 2010 and Akhtar *et al*., 2000. Albassam, 2001; Flores *et al*., 2003). Moreover, increasing weeding periods decreased grain weight (Matloob *et al*., 2015; Nadeem *et al*., 2008 and Zubair *et al*., 2009.

Plant height (cm): Various nitrogen levels and weeding intervals had significantly affected plant height of maize. Data in table 1 illustrated that the highest maize plants (220.7 cm) were noticed in 200 kg ha^{-1} nitrogen level treatments while shorter plants (190.5cm) were observed in zero nitrogen level treatments. More nitrogen enhanced cell division which ultimately increased the plant height (Ali *et al*., 2016; Amanullah *et al*. 2014 and Wajid *et al*. 2007). Moreover, variation in plant height might be due to increasing weed competition (Nadeem *et al*., 2008). According to Matloob *et al*., 2015 more competition duration adversely affected plant height.

Biological yield (kg ha^{-1}): Various nitrogen levels and weeding intervals had significantly affected biological yield of maize. The table 1 showed maximum of 10189 kg ha^{-1} in 200 kg ha^{-1} N plots and minimum of 7167 kg ha^{-1} biological yield in 0 N plots. Nitrogen increased photosynthesis and cell division which eventually resulted in greater biological yield (Hammad *et al*., 2011a).

For weeding intervals maximum (9272.9 kg ha^{-1}) and minimum (8045.9 kg ha^{-1}) (8045.9 kg ha^{-1}) was noticed in control plots (Munsif *et al*., 2009 and Ali *et al*., 2011). The trend lines showed that biological yield of maize was inversely proportional to increased in weed competition time periods (Fig. 2).

Grain yield (kg ha^{-1}): Various nitrogen levels and weeding intervals had significantly affected grain yield of maize. Table 1 had maximum grain yield (6268.3 kg ha^{-1} in 200 kg ha^{-1}) and minimum (4216.8 kg ha^{-1} in 0 kg ha^{-1}) plots. High nitrogen level increased thousand grain weight which resulted in more grain yield. Increased in nitrogen level might increase the dry matter production in maize (Ali *et al*., 2016 and Amanullah *et al*. 2014). Variation in grain yield due to nitrogen rates might be because of the differences in growth parameters like thousand grain weight etc. (Hammad *et al*., 2011b; Khaliq *et al*., 2009; Jalali *et al*., 2012 and Maqbool *et al*., 2006).

Weed periods showed maximum 5060.4 kg ha^{-1} in W_0 and less 3337.6 kg ha^{-1} grain yield in W_6 treatments. An inverse effect on grain yield was observed with increase in weeding interval. Decreased in grain yield might be due to competition for resources (Safdar *et al*. 2016 and Husseini *et al*., 2008).

Significant interaction was noticed between weeding intervals and nitrogen levels. The intercept clarified quadratic relationship between grain yield and N levels (Fig. 3). The R^2 values at various nitrogen levels i.e., N_0, N_1, N_2 and N_3 were 96, 95, 98 and 91%, respectively. The trend lines showed that there was a gradual decreased in grain yield with increased in weeding periods however, no decreased was noticed beyond W_4 in all nitrogen levels. The interactions showed that weeds should be controlled in early periods for achieving better grain yield. These results similar to Sabir *et al*., (2000) and Younas *et al*., (2002). According to Maqbool *et al*., (2006) weed duration affects grain yield significantly.

Table 1. Effect of N and weed periods on below parameters.

Nitrogen levels (N)	Weed density (m^{-2})	Thousand grain weight (g)	Plant height (cm)	Biological yield (kg ha^{-1})	Grain yield (kg ha^{-1})
N_0 = 0 kg ha^{-1}	93.2b	286.1c	190.5c	7167.0d	4216.8d
N_1 = 100 kg ha^{-1}	140.1a	452.3b	212.3b	7548.0c	5027.8c
N_2 = 150 kgha^{-1}	148.2a	504.4ab	211.5b	9165.1b	5545.6b
N_3 = 200 kgha^{-1}	148.7a	563.2a	220.7a	10189.0a	6268.3a
$LSD_{(0.05)}$	20.68	76.1	7.92	216.06	24.76
Weeding intervals (WI)					
W_0 = Weed free throughout	0.00	609.4a	216.0a	9272.9a	5060.4a
W_1 = Weeding after 15 days	129.7d	560.2a	208.6a	9036.3b	4572.1b
W_2 = Weeding after 30 days	129.8d	457.1b	209.5a	8721.4c	4097.5c
W_3 = Weeding after 45 days	144.4c	409.8b	214.4a	8440.7d	3575.3d
W_4 = Weeding after 60 days	165.9b	447.6b	211.1a	8053.2e	3411.0e
W_5 = Weeding after 75 days	171.5b	408.4b	209.5a	8050.8e	3349.3e
W_6 = Weed Infested	186.8a	274.1c	192.4b	8045.9e	3337.6e
$LSD_{(0.05)}$	10.90	0.07	12.15	41.19	138.13
Interaction (N x W)	*	NS	NS	*	*

$p \leq 0.05$ LSD test were used

Table 2. Correlation data.

		Grain yield	p-value
Nitrogen levels	Weed density	0.433	0.0001
Weeding intervals	Weed density	-0.473	0.0349

Correlation is significant at 0.05 level

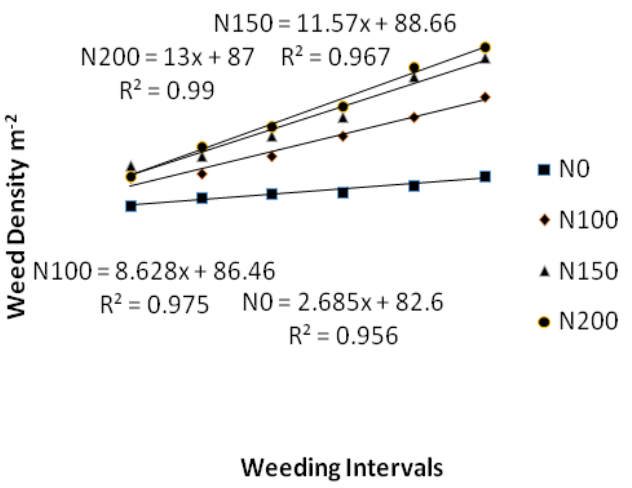

Fig. 1. Response of Nitrogen levels and the weeding intervals on the Weed density (m^{-2}).

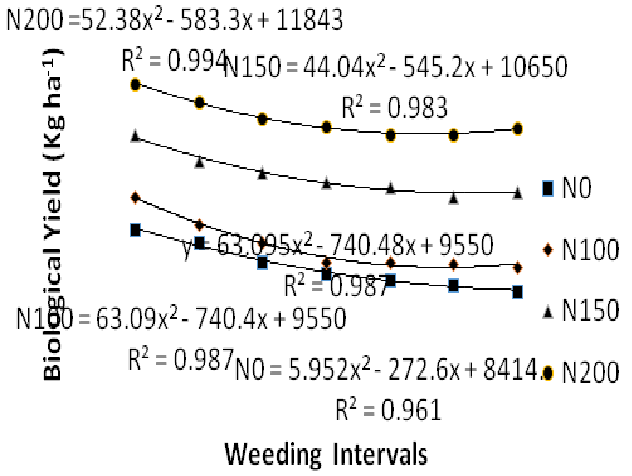

Fig. 2. Response of Nitrogen levels and the weeding intervals on Biological yield (kg ha^{-1}).

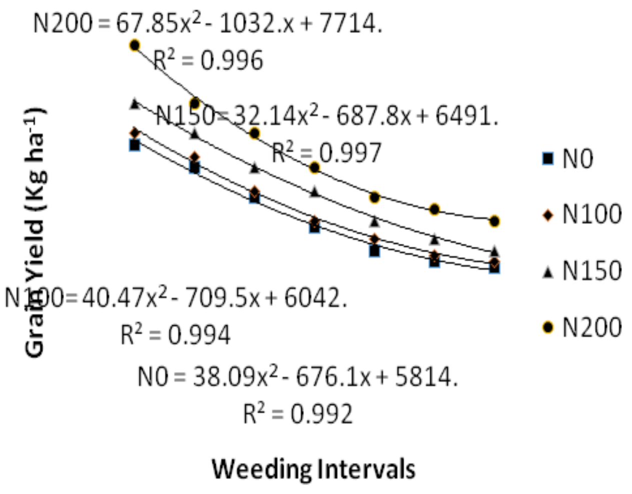

Fig. 3. Response of N and the weed periods on grain yield.

Conclusion

The results indicated that different weeding periods and various levels of N had significantly affected the maize yield etc. Thus in light of the experimental results it is recommended that management of weeds should be done prior 30 days after sowing with N @ 200 kg ha^{-1} in Peshawar-Pakistan.

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