academicJournals

Vol. 10(24), pp. 659-663, 30 December, 2015
DOI: 10.5897/SRE2015.6313
Article Number: FD7A03156713
ISSN 1992-2248

http://www.academicjournals.org/SRE

Scientific Research and Essays

Full Length Research Paper

Influence of fertility levels and weed management practices on yield and yield attributes of rain-fed maize

S. Gul[1]* and B. A. Khanday[2]

[1]Dryland (Karewa) Agricultural Research Station, India.
[2]Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, (J&K), India.

Received 12 August, 2015; Accepted 9 September, 2015

Investigating the response of rain-fed maize to fertility levels and weed management practices, a field trial was undertaken in 2012 and 2013 at Experimental Farm, D(K)ARS, SKUAST-Kashmir, (J&K). The experiment consisted of 3 fertility levels and 4 weed management practices. The results revealed that fertility levels F_3 and F_2 at par with one another recorded significant increase in cob length, number of cobs plant^{-1}, number of grains cob^{-1}, 100-seed weight, grain yield, and stover yield as against F_1 during both the years, however, number of rows cob^{-1}, cob diameter showed significant and consistent improvement with increase in fertility level from F_1 to F_3 during both years of study. Further, fertility levels F_3 recorded significant increase in biological yield over F_1, however, increase in fertility level from F_1 to F_2 increased the harvest index significantly during both years of study. Weed management practices W_2 being at par with W_3 recorded significant improvement in all yield contributing characters over W_1 and W_0. Both grain and stover yields were significantly higher with W_2 over W_1 and W_0, however, it was at par with W_3 during 2012 and 2013. W_3 and W_2 at par with one another recorded significantly higher biological yield and harvest index over W_1 and W_0 during both the years of experimentation.

Key words: Fertility levels, weed management, yield, yield attributes, rain-fed maize.

INTRODUCTION

Maize (*Zea mays* L.), belonging to the grass family Gramineae, is believed to have originated from Mexico or Central America and spread to West Africa with early European traders in the 16th century. It is the third most important cereal in the world after rice and wheat. It is produced throughout the country under diverse environments. About 54% of the world is suitable for rain-fed agriculture, whereas 80% of agricultural production is form rain-fed areas (Valipour, 2013). Maize is generally grown as rain-fed crop in most of the areas of the world and its productivity is lower, compared to the crop grown under irrigated conditions, however, under irrigated conditions its productivity and intensity can be increased due to maximum utilization of inputs (Valipour, 2014). It is an important source of proteins (10.4%), fat (4.5%), starch (71.8%), fiber (3%), vitamins and minerals like Ca,

*Corresponding author. E-mail: shamimgul324@gmail.com

P, S and small amounts of Na. Its flour is considered to be a good diet for heart patients due to its low gluten (protein) content (Hamayun, 2003).

Plant nutrition is a key input to increase the productivity of maize crop. Out of several nutrients provided to plants, nitrogen is a major and limiting nutrient for better plant growth and yield, as this crop is exhaustive in nature and requires more energy. It is considered as most important nutrient for the crop to activate the metabolic activity and transformation of energy, chlorophyll and protein synthesis. It governs better utilization of potassium, phosphorus and other elements and constitutes 40 to 50% of protoplasm of plant cell on dry weight basis and can be a limiting factor under such conditions. Phosphorous is another fascinating plant nutrient. It is involved in wide range of plant processes right from cell division to development of good root system. It plays major role in hastening crop maturity and ensures timely and uniform ripening of the crop. It is constituent of ADP and ATP, the most important substance in the life processes. Potassium is an essential nutrient and is also the most abundant cation in plants. It plays essential roles in enzyme activation, protein synthesis, photosynthesis, osmo-regulation, stomatal movement, energy transfer, phloem transport, cation-anion balance and stress resistance. The major limitation for plant growth and crop production under rain-fed condition is soil water availability. Plants that are continuously exposed to drought stress can form reactive oxygen species (ROS), which leads to leaf damage and, ultimately, decreases crop yield. During drought stress, root growth and the rates of K^+ diffusion in the soil towards the roots are both restricted, thus limiting K acquisition. The resulting lower K concentrations can further depress the plant resistance to drought stress, as well as K absorption. Maintaining adequate plant K is, therefore, critical for plant drought resistance.

Control of weeds is yet another important practice to increase the productivity of this crop under rain-fed conditions. Farmers usually give prime importance to few cultural practices and neglect other factors like weed control. As the maize is usually grown during the hot summer months of May and June when manual method of weed control is difficult to employ therefore, other methods of weed control are more feasible, less laborious, cost effective and economical. Weed management strategies attempt to limit the deleterious effects of weeds growing with crop plants. These effects could be quite variable, but the most common is competition for available resources. The quantities of growth factors used by weeds are thus unavailable to the crop. As there are limitations of every weed control method therefore integrated weed management is a good option for sustainable agriculture. Keeping in view the above points, the present study was undertaken to determine the effect of fertility levels and weed management practices on yield and yield attributes of rain-fed maize.

MATERIALS AND METHODS

The investigation was conducted during *kharif* 2012 and 2013 at Dryland (Kerawa) Agriculture Research Station, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Budgam. The area lies between 34° 0.8′ N latitude and 74° 83′ E longitude at an altitude of 1587 m above the mean sea level. The mean maximum temperature ranged from 24.3 to 31.5°C and minimum from 9.7 to 17.60°C during first growing season and 21.22 to 32.2 and 8.2 to 19.8°C during second growing season. The total rainfall received during the entire growing season of 2010-11 and 2011-12 amounted to 383.70 and 426.10 mm, respectively. The experiment was laid out in randomized block design with combination of 3 fertility levels (viz., F_1 = 60:40:20, F_2 = 75:50:30 and F_3 = 90:60:40, $N:P_2O_5:K_2O$ kg ha^{-1}) and 4 weed management practices (viz. W_0 = No weeding, W_1 = Hand weeding 20 and 50 days after sowing, W_2 = Atrazine at 1.0 kg a.i. ha^{-1} (pre-emergence) + hand weeding 20 days after sowing and W_3 = Atrazine at 1.0 kg a.i. ha^{-1} (pre-emergence) + Isoprotron at 1.0 kg a.i.ha^{-1} (post-emergence) with 3 replications. Prior to sowing, the field site was three times ploughed approximately 30 cm deep using a cultivator to destroy all types of the growing vegetation and then planking was done to prepare fine seed bed for sowing the seed. The maize variety "C6" was sown at a spacing of 75 cm × 20 cm between rows and plants. The trial was irrigated when required. Full dose of phosphorus and potassium and $1/3^{rd}$ of nitrogen were band placed as per the treatments just before sowing of seed. Remaining nitrogen was top dressed in two equal splits at knee high and tasselling stages. Nitrogen, phosphorus and potassium were applied through urea, diammonium phosphate and muriate of potash, respectively.

For recording of data on yield attributes viz., cob length (cm), cobs $plant^{-1}$, grains cob^{-1}, cob diameter (cm), number of rows cob^{-1} and 100-grain weight (g) number of cobs of five randomly selected plants from each plot were used. After harvesting the crop, cobs and stalks were properly sun dried and bundled. The bundle weight of each net plot was recorded and was expressed as biological yield in q ha^{-1}. The grain yield of each net plot was thoroughly cleaned and sun dried. The yield from each plot was recorded separately as kg $plot^{-1}$ and then converted in q ha^{-1}. After removal of the cobs from stalks in each net plot, the stalks were weighed to determine the stover yield in q ha^{-1}. Harvest index (%) was determined by dividing the weight of grains per plot at 15% moisture content by total produce per plot and multiplying by 100.

$$\text{Harvest index} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

The data obtained in respect of various observations were statistically analyzed by the method described by Cochran and Cox (1963). The significance of "F" and "t" was tested at 5% level of significance. The critical difference was determined when "F" test was significant.

RESULTS AND DISCUSSION

Fertility levels

The investigation revealed that yield contributing character viz., cob length and diameter, number of cobs per plant, grain rows and number of grains per cob and 100-grain weight increased significantly upto F_2 (75:50:30) level beyond which difference was unmarked (Table 1). Higher cob length and diameter obtained at F_2 (75:50:30) level might be due to sufficient supply of nitrogen to the crop because nitrogen being as essential constituent of plant tissue is involved in cell division and cell elongation. Moreover, higher cob length and diameter values noticed at F_2 (75:50:30) level means the production of more photosynthates leading to increase in grain number and weight of grains. Rasheed et al. (2003) and Onasanya et al. (2009) have also reported similar findings. Besides increase in 100-grain weight might be due to enhancement in source efficiency as well as sink capacity (Maqsood et al., 2000).

The study revealed that seed yield increased significantly upto fertility level F_2 (75:50:30) beyond which level the difference was unmarked (Table 2). The yield components viz., cobs per plant, grains per cob and grain weight increased significantly upto F_2 (75:50:30) level thereby the combined effect of these components resulted in yield increase. Similar effect of fertilizer levels on maize yield and its components was reported by Maqsood et al. (2000). The stover yield also showed increasing trends as that of grain yield. The higher uptake of nutrients by the crop produced healthy plants meaning more production of photosynthates leading to higher dry matter production in terms of grain and stover/biological yield. Abdullah et al. (2007) and Ghaffar et al. (2012) also reported similar findings. The harvest index showed significant improvement with increase in fertility level from F_1 (60:40:20) to F_2 (75:50:30) but significantly decreased with increase in fertility level from F2 (75:50:30) to F3 (90:60:40). Harvest index reflects physiological efficiency of the crop. Higher harvest index obtained with F_2 (75:50:30) level means that the capacity of photosynthates to translocate from source to economic part (grain) was higher. Mahmood et al., (1999), Bakht et al. (2007) and Onasanya et al. (2009) also reported an increase in harvest index with application of N, P and NPK.

Weed management practices

Various yield contributing characters viz., cob length and diameter cobs per plant grain rows and number of grains per plant and 100-seed weight (Table 1) recorded under W_2 (atrazine at 1.0 kg a.i. ha^{-1} pre-emergence + hand weeding 20 DAS) and W_3 (atrazine at 1.0 kg a.i. ha^{-1} pre-emergence + isoprutron *at* 1.0 kg a.i. ha^{-1} post emergence) treatment as well as unweeded treatments were significantly higher than other weed control treatment as well as unweeded treatment. In fact reduced weed competition due to application of atrazine as pre-emergence allowed the crop stand growth better and utilize the available nutrients especially nitrogen which is because of its cell division and cell elongation role improved cob length and diameter as well as number of cobs per plant. Higher number of grains per cob could be attributed to better translocation of metabolites for seed development and decrease in number of grains in W_1 (hand weeding 20 and 50 days after sowing) and W_0 (no weeding) treatments was due to increase in weed competition (Bibi, 2010). Patel et al. (2006) reported that maximum 100-seed weight was recorded with pre-emergence application of atrazine at 0.50 kg a.i ha^{-1} in combination with pendimethalin at 0.25 kg a.i ha^{-1}.

The results of the investigation reveal that the lowest grain yield was found under unweeded treatments (Table 2). This could be attributed to greater renewal of nutrients and moisture by weeds and a severe crop weed competition resulted in poor source and sink development with poor yield components. The results could be collaborated with the findings of Sinha et al. (2003) and Kolage et al. (2004). Among weed control treatments W_2 (atrazine at 1.0 kg a.i. ha^{-1} pre-emergence + hand weeding 20 DAS) followed by W_3 (atrazine at 1.0 kg a.i. ha^{-1} pre-emergence + isoprutron at 1.0 kg a.i. ha^{-1} post emergence) recorded maximum grain yield which could be attributed to improved yield component viz.; higher number of cobs/plant, grains per cob and 100-grain weight. This improvement in turn was due to higher dry matter production and distribution in different parts (Kamble et al., 2005). This implies that with effective and efficient weed control, more plant nutrients are made available to the crop for enhanced leaf area formation that increases solar radiation interception thereby favouring better utilization of photosynthesis for higher grain yield.

Both stover and biological yield were also significantly higher under W_2 (atrazine at 1.0 kg a.i. ha^{-1} pre-emergence + hand weeding 20 DAS) and W_3 (atrazine at 1.0 kg a.i. ha^{-1} pre-emergence + isoprutron at 1.0 kg a.i. ha^{-1} post emergence) treatments (Table 2). Higher biological yield and stover yield is the effect of higher plant height, more number of functional leaves and higher dry matter production. Harvest index is defined as a ratio of yield biomass to the total biomass at harvest (Worku and Zelleke, 2007). During the study it was found that lowest harvest index was observed under no weeding W_0 (no weeding)) treatment which could be attributed to higher partitioning of assimilates to vegetative biomass at the expense of sink (grains). Significantly higher harvest index was observed under W_2 (atrazine at 1.0 kg a.i. ha^{-1} pre-emergence + hand weeding 20 DAS) treatment though at par with W_3 (atrazine at 1.0 kg a.i. ha^{-1} pre-emergence + isoprutron at 1.0 kg a.i. ha^{-1} post emergence). This could be attributed to adequate suppression of weed growth as well as more availability of plant nutrients to maize crop which favoured better utilization of photo-assimilates for grain yield formation. Similar results have been discussed by Subhan et al. (2007), Riaz et al. (2007) and Khan et al. (2012).

Table 1. Yield contributing characters of maize as affected by fertility levels and weed management practices.

Treatment	Cob length (cm)	Cobs plant^{-1}	Grains cob^{-1}	Cob diameter (cm)	No. of rows cob^{-1}	100-grain weight (g)	Biological yield	Harvest index
Fertility levels (2012)								
F_1	11.49	1.06	318.94	1.73	14.29	19.81	108.35	39.44
F_2	13.96	1.12	332.94	2.09	16.31	20.66	115.16	40.31
F_3	14.23	1.12	334.94	2.14	17.10	20.71	117.27	40.07
SE(m) $\pm$	0.10	0.01	1.84	0.09	0.25	0.27	1.89	0.03
CD (p=0.05)	0.31	NS	5.67	0.28	0.75	0.85	5.83	0.09
Weed management (2012)								
W_0	11.83	1.06	312.00	1.58	12.83	18.70	101.88	39.31
W_1	12.91	1.10	327.37	1.93	15.94	20.02	110.40	39.59
W_2	14.11	1.12	340.53	2.23	18.63	22.27	122.69	40.71
W_3	14.06	1.11	337.46	2.21	16.19	21.26	119.40	40.66
SE(m) $\pm$	0.06	0.02	1.86	0.09	0.26	0.29	2.06	0.04
CD (p=0.05)	0.20	NS	5.74	0.28	0.78	0.92	6.36	0.14
Fertility levels (2013)								
F_1	14.49	1.08	330.40	1.84	14.88	19.83	109.45	40.26
F_2	15.85	1.13	336.80	2.17	16.48	21.58	117.06	41.00
F_3	16.19	1.14	340.00	2.25	17.22	21.83	119.07	40.55
SE(m) $\pm$	0.27	0.01	1.68	0.04	0.23	0.31	2.09	0.05
CD (p=0.05)	0.84	0.02	5.18	0.13	0.67	0.97	6.43	0.15
Weed management (2013)								
W_0	14.05	1.09	319.24	1.78	13.92	18.59	103.58	40.03
W_1	15.09	1.11	335.20	2.06	16.11	20.29	112.12	40.24
W_2	16.45	1.13	346.40	2.31	17.92	22.38	124.25	41.13
W_3	16.21	1.13	343.20	2.20	16.80	22.07	120.82	41.03
SE(m) $\pm$	0.30	0.01	2.05	0.05	0.24	0.32	2.33	0.05
CD (p=0.05)	0.94	0.03	6.34	0.15	0.69	1.01	7.20	0.16

Table 2. Seed and stover yield (q ha^{-1}) of maize as affected by fertility levels and weed management practices.

Treatment	Seed yield		Stover yield	
	2012	2013	2012	2013
Fertility levels (N:P:K kg ha^{-1})				
F_1 (60:40:20)	44.60	45.68	67.75	67.78
F_2 (75:50:30)	46.58	47.99	68.59	69.07
F_3 (90:60:40)	46.99	48.28	70.27	70.79
SE(m) $\pm$	0.19	0.17	0.73	0.59
CD (p=0.05)	0.59	0.53	1.85	1.04
Weed management				
W_0	40.83	42.27	63.05	63.31
W_1	44.89	46.32	68.51	68.80
W_2	49.54	50.69	72.14	72.56
W_3	48.96	49.99	71.45	71.83
SE(m) $\pm$	0.24	0.26	0.75	0.65
CD (p=0.05)	0.74	0.82	1.94	1.21

Conflict of Interest

The authors have not declared any conflict of interest.

ACKNOWLEDGEMENT

Authors are thankful to Division of Agronomy and Dryland (Karewa) Agricultural Research Station, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Srinagar (J&K, India) for extended research and financial support.

REFERENCES

Abdullah GH (2007). Effect of planting methods and herbicides on yield and yield components of maize. M.Sc (Hons) Thesis, Agricultural University of Peshawar, Pakistan.

Bakht J, Siddique MF, Shafi M, Akbar H, Tariq M, Khan N, Zubair M, Yousef M (2007). Effect of planting methods and nitrogen levels on the yield and yield components of maize. Sarhad J. Agric. 23(3):553-559.

Bibi Z, Khan N, Akram M, Khan Q, Khan MJ, Batool S, Makhdum K (2010). Integrating cultivars with reduced herbicides rates for weed management in maize. Pak. J. Bot. 42(3):1923-1929.

Cochran WG, Cox GM (1967). Planning and analysis of non-experimental studies. In: Proceedings of the Twelfth Conference on the Design of Experiments in Army Research and Testing, ARO-D Report. 67(2):319-36.

Ghaffar A, Ehsanullah N, Akbar SH, Khan K, Jabran RQ, Hashmi AI, Ali MA (2012). Effect of trench spacing and micronutrients on growth and yield of sugarcane (*Saccharum officinarum* L.). Aust. J. Crop Sci. 6:1-9.

Hamayun M (2003). Effect of spacing and weed free periods on the productivity of maize (*Zea mays* L.). Pak. J. Weed Sci. Res. 9(3&4):179-184.

Kamble TC, Kakade SU, Nemade SU, Pawar RV, Apotikar VA (2005). A integrated weed management in hybrid maize. Crop Res. Hisar. 29(3):396-400.

Khan NW, Khan N, Khan IA (2012). Integration of nitrogen fertilizer and herbicides for Efficient weed management in maize crop. Sarhad J. Agric. 28(3):457-63.

Kolage AK, Shinde SH, Bhilare RL (2004). Weed management in *kharif* maize. J. Maharashtra Agric. Univ. 29(1):110-111.

Mahmood T, Saeed M, Ahmad R (1999). Water and potassium management for enhanced maize (*Zea mays* L.) productivity. Int. J. Agri. Biol. 1(4):314-317.

Maqsood M, Ali R, Nawaz N, Yousaf N (2000). The effect of NPK application in different proportions on the growth and yield of spring maize. Pak. J. Biol. Sci. 3(2):356-357.

Onasanya RO, Aiyelari OP, Onasanya A, Oikeh S, Nwilene FE, Oyelakin OO (2009). Growth and yield response of maize (*Zea mays* L.) to different rates of nitrogen and phosphorus fertilizers in Southern Nigeria. World J. Agric. Sci. 5(4):400-407.

Patel VJ, Upadhyay PN, Patel JB, Patel BD (2006). Evaluation of herbicide mixtures for weed control in maize (*Zea mays* L.) under Middle Gujarat conditions. J. Agric. Sci. 2(1):15-20.

Rasheed M, Hussain A, Tariq MT (2003). Growth Analysis of Hybrid Maize as Influenced by Planting Techniques and Nutrient management. Int. J. Agric. Bio. 5(2):169-171.

Sinha SP, Prasad SM, Singh SJ, Sinha KK (2003). Integrated weed management in winter maize (*Zea mays*) in North Bihar. Indian J. Weed. Sci. 35(3/4):273-274.

Subhan F, Din N, Azim A, Shah Z (2007). Response of maize crop to various herbicides. Pak J. Weed Sci. Res. 13(1-2):9-15.

Valipour M (2013). Necessity of irrigated and rainfed agriculture in the world. Irrigat. Drainage Sys. Eng. S9: e001. pp. 1-3, doi:10.4172/2168-9768.S9-e001.

Valipour M (2014). Land use policy and agricultural water management of the previous half of century in Africa. Appl. Water Sci. DOI 10.1007/s13201-014-0199-1.

Worku M, Zelleke H (2007). Advances in improving harvest index and grain yield of maize in Ethiopia. East African J. Sci. 1(2):112-119.