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Research article

EFFECTS OF ROW SPACING, NITROGEN AND POTASSIUM FERTILIZER ON YIELD OF SILAGE CORN AFTER WHEAT HARVESTING

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ABSTRACT: To determine the effect of row spacing, nitrogen and potassium fertilizer on silage yield and its dependents components on corn (Zea mays L.cv.Sc704), an experiment was done as split-split plot in randomized complete block design based with four replications. Row spacing was chosen as main plots including: 65cm, 75cm and 85cm, three levels of N (250, 350 and 450 kg ha-1) in sub plots and three levels potassium (100, 150 and 200Kg/ha) in sub-sub plots were laid out. The results indicated that row spacing, were affected on plant dry weight, dry ear weight, dry leaf and dry stem weight. While the silage yield, ear yield, leaf yield, plant dry weight and dry ear weight, were affected by nitrogen and showed significant difference. Potassium had significant difference on plant dry weight, dry leaf and dry stem weight. The most silage yield (42/23t/ha) and dry plant weight (13.88 t/ha)obtained from 65cm row spacing that dry plant weight had significant difference with other row spacing. Amount of 450kg/ha nitrogen was caused the most silage yield (41/6t/ha) and plant dry weight (13.36 t/ha) that had not significant difference with usage of 350kg/ha nitrogen. The most silage yield (40/75t/ha) obtained from 200kg/ha potassium that had not significant difference with other potassium usage levels. The most plant dry weight (13.36) obtained from 150kg/ha potassium that had not significant difference with 200 kg/ha potassium usage levels

Key words: Corn, nitrogen and potassium fertilizer, row spacing.

INTRODUCTION

Maize (Zea mays L.) ranks third after wheat and rice in the world food grain production. It is grown extensively with equal success in temperate, sub-tropical and tropical regions of the world. Maize is one of the most widely grown cereals in the world and has great significance as human food animal feed and raw material. In most developing countries, about 50 to 55 percent of the total maize production is consumed as food [4].Corn (Zea mays L.) silage production is very important in winter in the north of Iran that producer need to forage, but deceasing temperature and solar energy in delay sowing date resulting in low silage yield because farmers used from common plant density, row spacing and plant pattern. So, seed row spacing is an agronomic management strategy used by producers to optimize the husbandry of the soil and plant ecosystem from sowing to harvest with the goal of bolstering the production of crops. Crop row spacing influences canopy architecture, which is a distinguishing characteristic that affects the utilization of light, water, and nutrients [19].Maize has high production potential especial under irrigated condition when compared to any other cereal crop. The productivity of maize largely depends on its nutrient requirement and management particularly that of nitrogen, phosphorus and potassium [4].Like nitrogen and phosphorus, potassium is major nutrition`s element contributing to large, steady and high crops. Crops need potassium and nitrogen in fairly comparable amounts, however every day agriculture stands proof to a lack of balance in the intake of these nutrients to the detriment of the potassium. Potassium is a multifunctional and high mobility element with direct and in direct influence on almost all biochemical and biophysiological processes.

It catalyzes numerous enzyme reactions. It helps the formation, transport and deposit of the products of photosynthesis in fruits, grains, tubercles and contributes to their transformation in fibers proteins, fats and vitamins. Potassium increases root growth and improves drought resistance; maintains turgor; reduces water loss and wilting reduces respiration, preventing energy losses; enhance strains location of sugars and starch; produces grain rich in starch, increases protein content of plants, builds cellulose and reduces lodging, helps retard crop diseases. Potassium plays significant roles in enhancing crop quality. High levels of available K improve the physical quality, disease resistance, and shelf life of fruits and vegetables used for human consumption and the feeding value of grain and forage crops. Quality can also be affected in the field before harvesting such as when K reduces lodging of grains or enhances winter hardiness of many crops [17].Nitrogen is a vital plant nutrient and a major yield determining factor required for maize production[1,20]. Nitrogen is a component of protein and nucleic acids and when Nitrogen is sub-optimal; growth is reduced [10]. Its availability in sufficient quantity throughout the growing season is essential for optimum maize growth. It is also a characteristic constituent element of proteins and also an integral component of many other compounds essential for plant growth processes including chlorophyll and many enzymes. It also mediates the utilization of phosphorus, potassium and other elements in plants [6]. The optimal amounts of these elements in the soil cannot be utilized efficiently if nitrogen is deficient in plants. Therefore, nitrogen deficiency or excess can result in reduces maize yields. Planting pattern is an imperative factor that determines the yield potential of maize crop [7]. Planting technique affects germination, water requirements of crop, growth and development of roots and exploitation of moisture from soil layers. Inputs such as water and nutrients are economically utilized if the plants are arranged in an appropriate pattern [2]. Radiation use efficiency is also influenced by planting methods. Planting corn in narrow rows results in an increased light interception for each plant. Hence, narrow rows boost photosynthetic activity and contribute significantly towards higher grain yield [22].

MATERIALS AND METHODS

The study was conducted at the Agricultural and Natural Resources Research Center of Mazandran, Qarakheil, Qaemshahr, Iran (31°28' N, 52°35' E) in 2014.The soil type was classified as loam. Some of its properties are: 26, 29 and 45 percent, clay, silt and sand, respectively, organic matter, 3.42% kg-1; pH, 7.2. Available N, P and K, were 0.17, 16.7 and 157 respectively. This experiment was laid out in split- split plot on the basis of randomized completely block design with four replication. Main plot was subjected to row spacing in three levels: 1. 65cm 2. 75 cm 3. 85cm. Other factors were nitrogen (Sub plot) in three levels (250, 350 and 450Kg/ha) and potassium (Sub-sub plot)in three levels (100, 150 and 200Kg/ha).

RESULTS AND DISCUSSION

The results indicated that row spacing, were affected on plant dry weight, dry ear weight, dry leaf and dry stem weight (table1). The highest ear yield was obtained in row spacing 65(Tables 2).Westgate et al [23], reported that light interception was not affected by corn row spacing. They found no yield advantage to growing corn in narrow (spacing of 0.38 m) rows vs. conventional (spacing of 0.76 m) rows over two growing seasons in Minnesota. Although the optimum row spacing varies among plant genus, yields will generally be maximized by sowing in rows that result in an equidistant spacing among plants [19].Pedersen and Lauer [15] found an 11% lower yield for corn grown in 0.19-m rows vs. 0.38- and 0.76-m rows in Wisconsin while Farnham [9] found a 2% lower yield for corn grown in 0.38-m rows vs. Widdicombe and Thelen [24], however, found that higher yields were attained for corn grown in narrow rows .The maximum reductions in weed density (9 %) and dry weight (34%) were recorded in 55 cm row spacing as compared with 75 cm row spacing [12]. However, the effect of row spacing on maize grain yield was non significant in both years while the silage yield , ear yield ,leaf yield , plant dry weight and dry ear weight, were affected by nitrogen and showed significant difference(table1). Amount of 450kg/ha nitrogen was caused the most silage yield (41/6t/ha) that had not significant difference with usage of 350kg/ha nitrogen (table2). Application rate of 120kgN/ha +40kgP/ha may be recommended for increasing maize yield particularly in the study area [14]. According to results of Moosavi [13], the treatment of optimum irrigation with minimum N level of 150 kg/ha is recommended for realizing high maize yield in Gonabad, Iran.

The optimum yield (2.26 t ha-1) was obtained by the combination of 25 cm intra row spacing, 82 kg N ha-1 and 1.91 t poultry manure ha-1 and should therefore be adopted by extra early maize farmers in Northern Guinea Savanna agro ecology [18]. Singh et al [21] also reported that application of 200 Kg N/ha increased grain yield of maize. Although nitrogen is the key element in increasing productivity and the increase of agricultural food production worldwide over the past four decades has been associated with a 7-fold increase in the use of N fertilizers [16], but large amount of fertilizer N loss to the environment could cause a serious environmental problem such as groundwater contamination [8].

In study comparing liquid swine manure with chemical N and P fertilizer sources, it was found that corn yield and N and P uptake was similar for both N sources [3]. The most silage yield (42/21t/ha) obtained from row spacing 65,450 nitrogen and 200kg/ha potassium. Application of NPK beyond treatment F2 (175-85-60) seems to be an un-economical and wasteful practice. K did not significantly increase N and P shoot uptake but K shoot uptake was increased by 18%. The strength of relationship between seed yield and N, P and K uptake was very strong [5]. The optimum rates of N and P for maize grown in the derived savanna were 100 and 40 kg ha-1respectively [11].

Table-1. Mean square effects of row spacing ,nitrogen and potassium on silage yield , Stem yield ,ear yield , leaf yield , plant dry weight , dry stem weight , dry ear weight , dry leaf weight .

Source of variation	DF	silage yield	Stem yield	ear yield	leaf yield	plant dry weight	dry stem weight	dry ear weight	dry leaf weight
Replicat	3	356.940ns	94.672*	47.978ns	9.417*	50.807**	17.304**	5.206**	0.782ns
Row spacing(A)	2	110.429ns	29.272ns	23.421ns	2.372ns	28.127**	6.982ns	3.346**	1.639*
Error	6	37.728	12.100	6.383	1.802	2.567	1.613	0.291	0.239
Nitrogen (B)	2	63.034*	9.405ns	14.183*	3.018ns	7.153ns	0.540ns	7.155ns	0.370ns
Error	18	13.400	6.104	2.708	0.953	2.464	0.744	1.107	0.655
Potassium(C)	2	9.390ns	8.461ns	0.881ns	0.537ns	10.290*	2.295ns	0.334ns	1.594ns
A xB xC	8	13.784ns	6.084ns	1.972ns	1.461ns	5.133ns	1.912ns	0.655ns	0.619ns
Error	54	13.024	6.024	2.836	0.894	2.986	0.909	0.965	0.546

*,** and ns significant at the 5% , 1% and non significant respectively

Table-2 .Means comparison effects of row spacing, nitrogen and potassium on silage yield, Stem yield ear yield, leaf yield, plant dry weight, dry stem weight, dry ear weight, dry leaf weight.

Source of variation	Silage yield T/ha	Stem yield T/ha	Ear yield T/ha	Leaf yield T/ha	Plant dry weight T/ha	Dry stem weight T/ha	Dry ear weight T/ha	Dry leaf weight T/ha
Row spacing								
65 cm	42.23a	19.37a	14.67a	8.192a	13.88a	6.510a	4.529a	2.842a
75 cm	38.86a	17.58a	13.46ab	7.680a	12.68b	5.701b	4.358a	2.618ab
85 cm	39.71a	18.67a	13.14b	7.899a	12.16b	5.804ab	3.936b	2.415
Nitrogen								
250 kg	38.80b	18.02a	13.04b	7.589b	12.47b	5.864a	3.866b	2.739a
350 kg	40.65a	18.55a	14.01a	8.085a	12.8ab	6.084a	4.206b	2.592a
450 kg	41.36a	19.04a	14.22a	8.097a	13.36a	6.067a	4.750a	2.544a
Potassium								
100 kg	39.73a	18.23a	13.71a	7.786a	12.32b	5.728b	4.206a	2.382b
150 kg	40.33a	18.29a	13.93a	7.965a	13.36a	6.222a	4.385a	2.755a
200 kg	40.70a	19.10a	13.63a	8.020a	13.03ab	6.066ab	4.232a	2.737a

Different letters in each Colum shows significant difference at %5 probability (DMRT).

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