http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences, 2 (2): 399-401, 1999 Research Article

Micro-Nutritional Studies in Pigeon pea

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Abstract

An experiment was conducted to study the effect of different levels of Zn, Fe, Cu and Mg on the growth and development of pigeon pea. It was observed that application of Zn alone caused earliness in 50 percent flowering and increased grain yield significantly. Zn and Fe alone showed earliness in maturity and gave maximum number of pods per plant (156.76 and 155.31) over control. The 1000-grain weight was significantly increased due to combined application of Zn, Fe and Cu.

Introduction

Pigeon pea (*Cajanus cajan* L.) locally known as arhar belongs to the family leguminosae. It is the 5th most important pulse crop of the world. It is a source of dry, split seeds (dhal) having protein content of 20-25 percent, green vegetable, human nutrition, feed for ruminants and a source of fuel in rural areas. In Pakistan pigeon pea is generally grown as a border crop around fields of sugarcane, cotton and ground nut. The rapid population growth rate of Pakistan increases the demand for food and shelter which ultimately necessitates the intensive crop production. Due to this intensive cultivation, plant nutrients begin to limit crop yield. One of the possible way to increase production is to assess the micro nutrient status of the soil and their classification on the basis of micro nutrient contents so that fertilizer recommendations could be made for the soils having an inadequate amount of the micro nutrients. Although micro nutrients are required in minute quantities but they play vital role in plant nutrition, enzymatic reactions and metabolic processes e.g Zinc is involved in the biosynthesis of IAA thus resulting in flowering and fruiting. It has positive rule in photosynthesis and N-metabolism. Iron has some role in chlorophyll synthesis, pigmentation and nitrogen fixation (Balakrishnan *et al*. 1992 and Oshodi *et al*. 1993). It has a catalytic role in the activities of several enzymes. Copper is concerned with the cellular oxidation and reduction. It is involved in the carbon assimilation and other metabolic processes. Magnesium is a constituent of chromosomes, polyribosome and chlorophyll. It is responsible for carbohydrate metabolism, phosphate transfer, decarboxylation and organic acid metabolism. The soils of Pakistan and particularly NWFP produce all types of crops and fruits. But due to poor management practices and insufficient use of fertilizers, the production is not of satisfactory level.

In view of present fertilization hazards in the region, the present experiment was designed to find out the effect of different doses and combinations of zinc, iron, copper and magnesium on the yield of Pigeon pea.

Materials and Methods

The experiment was carried out at Malakandher Farm of NWFP Agricultural University, Peshawar during 1995. The experiment was laid out in randomized complete block design with five replications and sixteen treatments. The sub plot size was 4 x 8 m with 9 rows, 45 cm apart from one another. The seed bed was thoroughly prepared before sowing the crop. A composite soil sample was taken from a depth of 0-15 cm and 15-45 cm before sowing of crop .for the determination of physical and chemical characteristics. The texture of the soils ranged from sandy loam to silty clay loam. The lime, organic matter, pH and electrical conductivity of the soils ranged from 0.13-15.24, 0.17-2.24, 7.2-8.6 percent and 0.14-1.10/dSm. The DTPA extractable Zn, Cu, and Fe content ranged from 0.49-6.08, 0.50-2.24 and 1.30-7.21 mg/kg respectively. Micro nutrients i.e Zn, Fe, Cu and Mg were applied at the rate of 0-5 kg ha^{-1} in the form of zinc sulphate (35% Zn), ferrous sulphate (20% Fe), copper sulphate (25% Cu) and magnesium sulphate (15.5% Mg) respectively in various combinations along with a basal dose of NP 25:50 kg ha^{-1}. All the recommended cultural and irrigation practices were followed throughout the growing season. The detail of treatments are given in Table 1.

The data collected in accordance with the above procedure were statistically analyzed by using the techniques and LSD test applied to evaluate the treatment difference.

Results and Discussion

Plant Emergence/m^2: It is elucidated from Table 2 that normally 17 plants were emerged/m^2 whether fertilizer applied or not. But statistically this opinion carries no weight as results were non-significant when subjected to DMRT to chalk out the mean differences obtained.

Days to Flowering: Difference in means noted for days to 50 percent flowering were significantly affected by zinc alone but non significant effect was observed due to Fe, Cu and Mg alone and in different combinations with Zn (Table 2). Days to 50 percent flowering were hastened by 5 kg Zn/ha. Zn deficient plants showed depressed growth and foliar symptoms. Days to flowering decreased with each increment of Zn up to a certain level. Fe was also found deficient in the soil when analyzed but had no significant effect on days to 50 percent flowering. It may be due to the fact that Fe is required by plant for the synthesis of chlorophyll pigment. Copper and magnesium alone and in different combination with zinc and iron showed non-significant effect on days to 50 percent flowering perhaps due to imbalance in dosage and antagonism of these nutrients (Mehrotra, 1991).

Table 1: Detail of the treatments used in the experiment

Treatments	Nutrients (kg ha^{-1})			
	Zn	Fe	Cu	Mg
1	0	0	0	0
2	0	0	0	5
3	0	0	5	0
4	0	0	5	5
5	0	5	0	0
6	0	5	0	5
7	0	5	5	0
8	0	5	5	5
9	5	0	0	0
10	5	0	0	5
11	5	0	5	0
12	5	0	5	5
13	5	5	0	0
14	5	5	0	5
15	5	5	5	0
16	5	5	5	5

Days to maturity: The number of clays to maturity was significantly reduced due to zinc and iron application while all other factors and their interactions were found non-significant. Copper and magnesium alone and in various other combinations with zinc and iron had no significant effect on number of days to maturity (Table 3). Mehrotra (1991) reported that Zn deficiency delayed flowering and fruit set and caused premature fall of flower buds. While Alia (1991) concluded that Zn stimulated the growth of seedling at low concentrations.

Number of pods per plant: Pods per plant were significantly different due to zinc and iron. While results observed due to copper and magnesium and their various interactions with zinc and iron were non-significant. The application of 5 kg each of Fe and Zn/ha produced more pods as compared to the control (Table 3). The application of optimum levels of zinc and iron might be the cause, because Zn and Fe were deficient in the experimental site. Copper and magnesium alone and in different combinations with zinc and iron could not produce any significant effect on this parameter. The results were in agreement with those of Mehrotra (1991) and Puste and Jana (1988) who found that Zn great influenced the number of pods per plant. Chandel *et al*. (1989) also reported that 5 kg Zn or Fe application increased number of branches and pods per plant. Rehman and Barnard (1988) reflected the contrasting results and stated that Zn had no significant effect upon number of branches and pods per plant.

Table 2: Mean number of plants emerged/m^2 and days 50 percent flowering of pigeon pea as affected the Zn, Fe, Cu and Mg

Treatments	Emergence/m^2	Days to 50% flowering
Control	17.476NS	92.000NS
Zin_0	17.485NS	91.150a
Zn_4	17.740NS	88.975b
Fe_0	17.514NS	88.975NS
Fe_5	17.712NS	89.700NS
Cu_0	17.486NS	90.550NS
Cu_5	17.740NS	89.575NS
Mg_0	17.319NS	89.975NS
Mg_5	89.975NS	90.150NS

Control = Zn_0, Fe_0, Cu_0, Mg_0, NS = Non significant, Means followed by different letters are significant different, using LSD test at 1% level of probability

Table 3: Mean days to maturity and pods per plant pigeon pea as affected by Zn, Fe, Cu and Mg

Treatments	Days to maturity	No of Pods per plan
Control	125.000NS	135.064NS
Zn_0	123.200a	141.764b
Zn_5	120.300b	156.765a
Fe_0	123.500a	143.215b
Fe_5	120.000b	155.314a
Cu_0	121.800NS	148.114NS
Cu_5	121.700NS	150.415NS
Mg_0	122.200NS	147.940NS
Mg_5	121.300NS	150.589NS

Control = Zn_0, Fe_0, Cu_0, Mg_0, NS = Non significant, Means followed by different letters are significant different, using LSD test at 1% level of probability

1000-grain weight: Differences in means for 1000-grain weight were significant due to Zn, Fe, and Cu interaction, but non-significant for Zn, Fe, Cu alone and in different combinations with Mg (Table 4). 1000-grains were mass in Zn, Fe and Cu combination but non-significant. The decrease in 1000-grain weight might be due to the availability of nutrients to the crop because plants always absorb nutrients in proper ratio, if there is deficiency of one essential nutrient it would hinder the activities of other elements. Singh *et al*. (1988) observed that applied Zn increased seed Zn content and Zn uptake and decreased P, Cu and Mn contents in seeds. These results confirmed he findings of Sarkar and Aery (1990) and Buzetti *et al*. (1989) who concluded that 1000-grain weight was significantly higher with complete treatment of micro-nutrients lacking iron.

Table 4: Mean 1000-grain weight (g) and grain yield (kg ha^{-1}) of pigeon pea as affected by Zn, Fe, Cu and Mg

Treatments	1000-grain wt. (g)	grain yield (kg ha^{-1})
Control	74.800NS	953.473NS
Cn_0	76.900NS	1043.473b
Cn_5	77.525NS	1133.134a
Fe_a	76.875NS	1054.742NS
Fe_s	77.550NS	1121.864NS
Cu_0	77.350NS	1081.742NS
Cu_5	77.075NS	1094.865NS
Mg_0	77.250NS	1096.473NS
Mg_5	77.175NS	1080.134NS

Control = Zn_0, Fe_0, Cu_0, Mg_0, NS = Non significant, Means followed by different letters are significantly different, using LSD test at 1% level of probability.

Grain yield: Grain yield was significantly affected by levels of Zn while Fe, Cu and Mg alone and their various interactions with Zn were non significant. Application of 5 g Zn/ha gave more yield as compared to the control (Table 1) as it was already deficient in the soil and might have glanced the micro-nutrient level. There was a decrease in yield due to the application of Fe, Cu, Mg alone and in different combinations with Zn. It might be due to the reason that their different levels disturbed the nutrient balance and induced deficiency of other elements. These results were supported by Mehrotra (1991), Payne *et al*. (1986), Afzal *et al*. (1987), Rehman and Barnard (1988), Singh *et al*. (1988), Chandel *et al*. (1989) and Sarkar and Aery (1990) who concluded that seed yield increased as Zn rates increased up to certain levels and were not further increased beyond critical level and also found that Zn deficient plants showed depressed yield. The effects were marked even under moderate Zn deficiency. Buzetti *et al*. (1989) stated that grain yield in pot and field trials was lowest with complete treatment (Fe, Cu, B, Mo) lacking Zn.

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