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Research Article

GROWTH AND YIELD PERFORMANCE OF KABULI CHICKPEA (*Cicer arietinum* L) GENOTYPES UNDER DIFFERENT PLANTING GEOMETRY AND FERTILITY LEVELS IN VINDHYA PLATEAU REGION

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Abstract- A filed experiment was conducted at R.A.K. College of Agriculture, Sehore farm during two continues Rabi seasons 2007-08 and 2008-09. This study aimed at evaluating the agronomic performance of two Kabuli chickpea genotypes under different planting geometry and fertility levels. The experiment was laid out in Factorial RBD with three replications. The experiment consisted of eight treatment combinations, two Kabuli chickpea genotypes (Phule G 95333 and Phule G 0515), two plating geometry and two fertility levels. The result revealed that the genotypes Phule G -95333 recorded significantly higher grain and straw yield (1655.13 and 2375.29 kg/ha) as compared to genotype Phule G-0515 (1311.21 and 1793.20 kg/ha) and it is also observed that the all growth and yield parameters were higher with genotypes Phule G-95333 followed by genotypes Phule G-0515. The planting geometry (30 x10 cm) with a population of 33 plant/ha recorded the highest grain and straw yield (1754.21and 2395.70kg/ha) as compared to planting geometry (45 x10 cm) with a population of 22 plants/ha (1212.12 and 1722.80 kg/ha). However yield components like branch/plant, pods/plant and seed index were higher with wider planting geometry (45 x10 cm). The higher fertility levels of 30 N + 60 P_2O_5 + 30 K_2O +20 S kg/ha produced higher values of grain and straw yield than lower fertility levels 20 N + 40 P_2O_5 + 20 K_2O+ 20 S kg/ha (1385.28 and 1979.35 kg/ha). The growth and yield parameters followed the similar trend. The study indicated that Kabuli chickpea Phule G-95333 has better response to closer planting geometry and higher fertility levels under both years investigation.

Keywords- Planting geometry, Fertility levels, Genotypes, Growth, Yield parameters

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Introduction

Chickpea (*Cicer arietinum* L) is an important grain legume in Asia and being a rich and cheap source of protein can help people to improve the nutritional quality of their diet [1]. The crop was a major role in the daily diet of rural community and poor sectors of urban population and its straw is used for animal feed. Chickpea also fetches good price when sold in local market and hence generates cash to farmers. Most production and consumption of chickpea (95%) takes place in developing countries. It was grown on about 11.9 million hectares in 2010. Chickpea production has increased over the past 30 years from 6.6 million metric tons to 10.0 million metric tons. Most chickpeas are grown in South Asia, which accounts for more than 75% of the world chickpea area. India is by far the largest chickpea producing country. Over the period 1978–80 to 2008–10, the area under chickpea in India increased marginally from 7.6 million hectares to 7.9 million hectares, but production increased by 40% (from 4.8 to 6.8 million metric tons). Other important chickpea producing countries are Pakistan, Turkey, Mexico, Canada and Australia [1] Madhya Pradesh is the largest producer of chickpea, which covers 2561 thousand hectares area with the total annual production of 2371 thousand tones with an average production of 927 kg/ha (Agriculture statistics-2006). Chickpea contributes 47% of the total pulse production and about 40% of total pulse growing area in the country [2] Chickpea (kabuli and desi) is the main source of dietary protein of the majority of Indians and it is grown as grain legume. Kabuli chickpea is specially used for table purpose as chhole. Its important source of protein and fiber. Chickpea contains 17-22% protein and 60-64% carbohydrates and 6% fat [3]. Chickpea being a leguminous crop, improve soil fertility by fixing atmospheric nitrogen in available from (NH_3^+ and NH_4^+) in the root through the phenomena of symbiosis. The optimum plant density with proper plant geometry is one of the important characters which can be manipulated to attain the maximum production from per unit land area. The grain yield of chickpea is highly dependent on plant population [4]. It is clear that both too narrow and too wide spacing do affect grain yield through competition for nutrients, moisture, solar radiation etc. and due to the effect of shading. In the letter case (too wide spacing), yield reduction can occur due to in efficient utilization of the growth factors. Normally, as population increases yield also increases proportionally, after it reached a certain level the yield declines. In this simultaneous opposing effect of the two components there should be a point where maximum yield is expected and that should be at the optimum spacing.

The average yield of chickpea is very low which can be attributed to factors such as water deficit, diseases, weed infestation, poor agronomic practices and without application of balance fertilizer. The rainfall being generally separative result in low production suitable status of moisture in the soil and balance fertilizer has a profound influence in the yielding capacity of chickpea. Phosphorus is one of the most important nutrients for chickpea (*Cicer arietinum* L.) also responds significantly. Phosphorus contributes directly to both the yield and quality of chickpea. It has often been called the "Master key of Agriculture". Phosphorus plays an important role in physiological functions of plant. It is a constituent of adenosine diphosphate (ADP), sugar phosphate and nucleic acid, proteins and several co-enzymes, which are of the great importance in energy transformation and metabolic process of the plants. The nitrogen fixation is much accelerated when optimum quantity of phosphorus is available in the soil. Potassium has a big impact on legume yield and may have a positive effect on nitrogen fixation and nitrogen accumulation in the plant. But the effect is not a direct one. Potassium and sulphur are also required for higher yield of chickpea. Sulphur is also recognized one of the major plant nutrient along with nitrogen (N), phosphorus (P), and potassium (K). It is very important for growth and development of all crops and that absorbed by plant in the form of sulphate ($SO4^{-2}$). Sulphur deficiency is becoming more critical with each passing year which is severely restricting crop yield, produce quality, nutrient use efficiency and economic returns on millions of farms.

Materials and Methods

The field experiments were conducted during two continues Rabi season 2007-08 and 2008-09 under the All India Coordinated Research Project on Chickpea (AICRP) at Sehore. The topography of the field was uniform. The soil of the experimental area was medium black clay loam in texture with slightly alkaline (pH 7.8) low in available nitrogen (151.2 kg/ha), medium in available phosphorus (13.8 kg./ha) and high in available potash (308 kg/ha).The experimental site, R.A.K. College of Agriculture, Sehore is situated on 27°12' North latitude and 77°0' East longitude at an altitude of 498.77 meter from sea level in Vindhyan plateau of Madhya Pradesh. The average rainfall varies from 1000 mm to 1300 mm concentrated mostly from June to September. Some rainfall also occurs during the winter season. The experiment consisted of eight treatment combinations of two genotypes (Phule G 95333 and Phule G 0515) two plant geometries (30 x10 cm with 33 plants/m^2) and (45 x10 cm with 22 plants/m^2) and two fertility levels (20N + $40P_2O_5$ + 20 K_2O + 20S and 30N + $60P_2O_5$ + $30K_2O$ + 20S kg/ha) were replicated three times in a factorial randomized block design. The different dose of fertilizer as per the treatment were applied in the form of DAP, single super phosphate, murate of potash, urea and gypsum, respectively as basal dose at the time of sowing. One light pre-sowing (palewa) irrigation was given for better germination and one irrigation was applied at pre-flowering stage. The seeds were treated with Thiram @ 2g + Carbendazim @1 g/kg seed. Sowing was done 13 Nov. 2007 and 30 Nov. 2008. The desired plant population as per the treatment was maintained by thinning after 15 days of sowing. The weeds were controlled by hand weeding and hoeing of 25-30 DAS.The growth and yield observations were recorded in five plants randomly selected in each treatment. After harvesting threshing, cleaning and drying was done. The weight of grain of each plot was recorded at dry weight basis.

Results and Discussion

Effects of genotypes

Genotypes Phule G-95333 differed significantly in grain yield in all the two years of investigation [Table-1]. The results indicated that the genotype Phule G-95333 produced significantly higher grain and straw yield as compared to genotype Phule G-0515 [Table-1]. Higher grain yield with genotype Phule G-95333 was due to significantly higher number of pods/plant and grain weight/plant over genotype Phule G-0515 [Table-1]. This was attributed to the efficient utilization of growth resources by Phule G-95333 than the Phule G-0515. The higher value of yield components with Phule G-95333 were also attributed to higher plant growth, number of branches per plant and more number of pods per plant [Table-1]. This favorable morphological phenomenon in this genotype resulted significantly highest yield per hectare. Similar results were reported by [5]. The bolder grain size alone in Phule G-0515 could not compensate for more pods and grain yield. In all the two years, similar trend to grain and straw yield were observed.

Effects of planting geometry

Grain yield per unit area increased with an increase of plant density up to a certain level and then decreased with further increase in plant density was observed in both the year investigation season. A plant geometry of 30 x10 cm with population of 33 plants/m^2resulted in significantly higher grain and straw yield over 45 x10 cm with 22 plants/m^2 [Table-1]. In all the two seasons the data on growth (except plant height) and yield contributing characters significantly higher with wider plant geometry [Table-1] while the highest grain yield was attained at higher in closer plant geometry in all the two seasons. With a closer plant geometry an increasing trends was observed in case of grain yield and plant height [Table-1]. The number of pods/plant decreased with increase in plant density while total number of pods per unit land area increased with increase in plant density therefore ultimately increased the yield of per plant thus resulting in higher grain yield at closer plant geometry. This result is in close conformity with reported by [6]. Hence the grain and straw yield significantly higher with plant geometry of 30 x10 cm with population of 33 plants/m^2 [Table-1]. The increase in grain and straw yield due to closer plant geometry levels have also been reported by [7-8]. The discussion clearly, suggest that individual plant under lower plant population performed better than plant under higher plant population the improvement in yield attributing parameters and yield per plant of individual plant under lower plant population was not sufficient enough to compensate the loss in density for higher seed yield.

Table-1 *Effect of Genotypes, Planting Geometry and Fertility levels on Growth, yield attributing characters and yield of Kabuli Chickpea*

Treatments	Plant height (cm)	No. of branches per plant	Number of pods/ plant	Seed Yield / Plant (g)	Seed Index (g)	Seed Yield (kg/ha)	Straw Yield (kg/ ha)
Genotype							
Phule G-95333	56.71	6.43	42.99	22.41	40.14	1655.13	2375.29
Phule G-0515	52.82	6.20	29.42	16.47	47.08	1311.21	1793.20
S.Em ±	0.50	0.06	0.83	0.76	0.33	49.01	46.23
CD at 5%	1.51	0.18	2.52	2.06	1.35	148.69	140.51
Planting Geometry							
33 plants /m^2 (30x 10 cm)	55.21	5.89	33.74	18.34	43.21	1754.21	2395.70
22 plants /m^2 (45 x10 cm)	54.32	6.74	38.67	20.55	45.03	1212.12	1772.80
S.Em ±	0.50	0.06	0.83	0.76	0.33	49.01	46.23
CD at 5%	NS	0.18	2.52	2.06	1.35	148.69	140.51
Fertility levels (kg/ha)							
20 N + 40 P_2O_5 + 20 K_2O+ 20 S	53.31	6.19	34.83	18.18	42.85	1385.28	1979.35
30 N + 60 P_2O_5 + 30 K_2O +20 S	56.22	6.44	37.57	20.70	44.38	1581.06	2189.29
S.Em ±	0.50	0.06	0.83	2.06	0.33	49.01	46.23
CD at 5%	1.51	0.18	2.52	2.06	1.35	148.69	140.51

(Pooled data of two years)

This discussion would lead to the conclusion that the plant geometry which is close conclusive to beat growth development and yield capacity of a community of plant over a unit area is highly desirable than that which provides condition for best development and yielding ability of individual plant. This result has been reported by [8-9].

Effects of fertility levels

Application of higher fertilizer dose30N + $60P_2O_5$ + $30K_2O$ + 20S kg/ha was recorded significantly higher growth, yield attributes and grain and straw yield compared to lower fertility level 20N + $40P_2O_5$ + 20 K_2O + 20Skg/ha. [Table-1]. The possible reason for increase in grain and straw yields under higher fertility levels could be that availability of additional amount of nutrients which favored the growth and development of better root system and might have helped in better uptake of nutrients. Further, it might have improved the rate of photosynthesis, as indicated in terms of higher values of growth and yield components that resulted in higher grain and straw yield of kabuli chickpea genotype Phule G-95333. Phosphorus is essential for cell division. Development of root nodules and stimulation of nitrogen fixation which might have enhanced the yield. The increase in grain and straw yield of chickpea with increased level of P_2O_5 may be attributed to better vegetative growth as observed by more plant height, branches and efficient nodulation and increased yield attributes (pods /plant and seed yield /plant) resulted in higher seed and stalk yield [Table-1]. [10-11] and [12] also reported such increase in grain and straw yield with increasing levels of phosphorus.

The sulphur is play important role for crop growth, yield and yield attributes as well as metabolic and enzymatic process. Sulphur is important for respiration, photosynthesis, and legume- Rhizobium symbiotic nitrogen fixation which reflected in increased yield. The similar results were also reported by [13-14]. Significant increase in plant height could be attributed to the fact that potassium enhances plant vigour and strengthens the stalk, further it has synergistic effect with nitrogen and phosphorous resulted in better plant growth and more number of branches/plant [3]. The increased branches/plant, pods/plant, grain weight/plant and 100-seed weight due to potassium application eventually contributed to higher grain yield. Similar results have been reported by [15-16]

None of the interactive effects were found significant hence they have not been described.

Conclusion

In conclusion, the results from the study indicated that closer plant geometry (30 x10 cm) and higher fertility level (30N + $60P_2O_5$ + $30K_2O$ + 20S kg/ha) had significantly influence on the growth, yield component and yield of kabuli chickpea. Hence above closer plant geometry and higher fertility levels can be tentatively suggested for the area, however the experiment has to be repeated over locations and season with inclusion of more variety, plant geometry and fertility levels to reach at a more reliable conclusion.

Application of research: To find out optimum planting distance and fertilizer dose for higher yield for kabuli chickpea under Vindhyan plateau region.

Abbreviation: CGIAR: Consultative group for International Agricultural Research Centers

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