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Growth and Yield of Chickpea (*Cicer arietinum* L.) as Influenced by Seed Rate and Seed Priming

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A B S T R A C T

The study on growth and yield of chickpea (*Cicer arietinum* L.) as influenced by seed rate and seed priming was conducted during *Rabi* 2017-18. The experiment consisted of nine treatment combinations of three seed rates *viz.* 60 kg, 80 kg and 100 kg ha^{-1} in main plots and three seed priming treatments *viz.* control, water and NaCl in sub plots were tested in split plot design with three replications. Plant growth parameters like emergence count and plant height (cm) was found superior with seed rate of 100 kg ha^{-1} whereas number of branches, fresh weight, dry weight and some yield attributes *viz.* number of pods plant^{-1} were recorded significantly superior with seed rate of 60 kg ha^{-1}. Seed rate of 80 kg ha^{-1} produced 28 and 21 per cent higher grain yield as compared to 60 kg and 100 kg ha^{-1} of seed rate. Water primed seeds produced 20 and 9 per cent higher grain yield as compared to control and NaCl. Among different seed rates and seed priming treatments, 80 kg ha^{-1} of seed rate and water primed seeds resulted 37 and 19 per cent higher net returns and 31 and 19 per cent higher benefit cost ratio as compared to other treatments.

Introduction

Yield of a crop is the result of final plant population which depends on the number of viable seeds, germination percentage and survival rates. Establishment of optimum plant population is imperative to get maximum possible yield. Inadequate plant population is one of the significant factors responsible for reduced grain yield of chickpea (Nagarajaiah *et al.*, 2005). The level of plant population should be so such that solar radiation is maximum intercepted. Plant population should not be high to deplete soil moisture before crop matures and not low to leave moisture utilization. Plant density is affected by genetic and environment factors. The full yield potential of individual plant is achieved in wide spacing as compared to densely sown. In dens planting competition among plant is more for growth factors resulting in the size and yield of plant. Yield per plant decreases gradually as plant population per unit area increases. Dry matter of individual plant increases with increase in plant population to a certain level. This indicates lack of appreciable competition between neighboring plants. Further incline in density increases dry matter of individual plant at a reducing rate. Inadequate plant population is one of the significant factors responsible for reduced grain yield of chickpea and it may be maintained by using superior and optimum seed rate. Further as chickpea is grown under rainfed and water stress conditions on marginal soils, the risk of crop failure may be reduced by using costly inputs including the use of high seed rate. Sowing of seeds after seed treatments like priming facilitated in improving seed viability and vigour of seed before sowing. Seed priming is simple and suitable method which can improve quality and yield of the seed. It is simple method which can improve germination rate and improved quality. The priming appears to reverse the harmful effects of deterioration of seed. Seed priming may increase the rate and uniformity of seed germination and seedling emergence, especially under stressful conditions. Seed treatment is recorded to increase the germination and improve the seedling emergence at changing soil moisture regime (Sarvjeet *et al.,* 2017). Some harmful effects of low vigour seed lots and environmental stresses are overcome by seed priming methods. This can increase the production of vigorous plants and help in to use plant resources efficiently. The seed priming with chemicals and growth regulators act as shielding agent against seed deterioration due to fungal invasion and physiological ageing as a result of which the seed viability was maintained for longer period. So keeping all the above facts in view, an attempt was made to study the effect of seed treatment and priming on storability of chickpea.

Materials and Methods

The field experiment was conducted during *Rabi* season of 2017-2018 at Campus of Research and Advanced Studies, Dhablan, Post Graduate Department of Agriculture, General Shivdev Singh Diwan Gurbachan Singh Khalsa College, Patiala, Punjab, India. Nine treatment combinations of three seed rates of cultivar *viz.* 60 kg, 80 kg and 100 kg ha^{-1} in main plots and three seed priming treatments *viz.* control, water and NaCl in sub plots were tested in split plot design with three replications. The recommended package of practices for cultivar PBG 7 was followed for other cultural operations.

Results and Discussion

Growth attributes

The data in Table 1 revealed that significantly higher emergence count per meter row length (21.22) was observed with seed rate of 100 kg ha^{-1}. It was also observed by Singh *et al.,* (2017) that emergence count per meter row length was significantly affected by seed rate due to more seeds present in soil utilize maximum moisture present in soil. Maximum plant height at harvest was observed with seed rate of 100 kg ha^{-1} (55.54 cm) (Table-1). It was observed by Cokkizg in (2012) that plant height enhanced with the increase in seed rate which is due to competition among plants for sunlight. It is clear from the data is that the significantly maximum number of branches was recorded with the seed rate of 60 kg ha^{-1} (31.46).Similar results were obtained bySharar *et al.,* (2001) who reported that highest number of branches plant^{-1} were reported at 40 kg ha^{-1} of seed rate and branches observed decreased with increase in the seed rate. Data present in Table-1 revealed that maximum dry weight production observed with seed rate of 60 kg ha^{-1} (19.79 g). Lone *et al.,* (2009) recorded that dry weight of seed rate of 40 kg ha^{-1} produced more dry weight than of seed rate 80 kg ha^{-1}. In case of seed priming it was observed that water primed seeds showed more emergence (19.44) as compared to non primed seeds. It was due to increase in protease and amylase activity and increase in level of hydrolyzing enzymes in primed seeds. A similar result was also recorded by Sarvjeet *et al.,* (2017). Table -1 showed that water primed plants produced tallest plants (52.79 cm). It might be due to cell enlargement and cell division that enhanced the plant growth through development of effective root system. In case of seed priming water primed seeds produced maximum number of branches (29.58). Shinde *et al.,* (2017) recorded that higher number of branches (33.8) with haloprimed seeds as compared to control which produce minimum branches (30.2) due to root and shoot elongation through cell division that might enhanced plant growth resulted in increase in the number of branches. It was observed from table 1 is that seed rate 60 kg ha^{-1} and water primed seeds showed maximum fresh weight (39.42 and 38.53). It was confirmed with Sohail *et al.,* (2018) who also reported that seed primed with polyethylene glycol produced more fresh weight as compared to control. Water primed seeds recorded significantly highest dry weight (18.32 g). A significant increase in dry matter of plant due to seed priming treatments was also reported by Elouaer and Hannachi (2012).

Yield attributes

Table -2 showed that a seed rate of 60 kg ha^{-1} produced maximum pods plant^{-1} (43.17). Sethi *et al.,* (2015) also found variations in number of pods plant^{-1} due to different seed rates and found that maximum pods plant^{-1} (20.54) was produced with seed rate of 100 kg ha^{-1}.A seed rate of 80 kg ha^{-1} recorded significantly higher seed index (22.25 g). This could be due to optimum plant population had probably better growing conditions and promote better nutrient supply for seed formation and development. This result is inclosing association with the finding of Nawange *et al.,* (2016). Seed rate of 80 kg ha^{-1} produced significantly higher seed yield (18.39 q ha^{-1}). This could be due to reasonably good number of pods plant^{-1}, seeds pod^{-1} and 100-seed weight. Similar result was observed by Khan *et al.,* (2010), who reported that seed rate of 75 kg ha^{-1} produced higher grain yield (28.36 q ha^{-1}).Seed rate had non-significant effect on straw yield. Higher straw yield was obtained from seed rate 80 kg ha^{-1} (20.34 q ha^{-1}) which was at par with seed rate of 60 kg (19.52 q ha^{-1}) and 100 kg ha^{-1} (18.42 q ha^{-1}). Results showed that non-significant effect of seed rate on straw yield. Straw yield is function of vegetative growth, which is governed by plant parameters i.e. number of branches plant^{-1} and number of leaves plant^{-1}.

Total biomass and environment conditions also affect straw yield of plant. Similar findings were also reported by Ray *et al.,* (2017) as he confirmed that straw yield have not significantly affected by seed rates. A seed rate of 80 kg ha^{-1} gave significant higher harvest index (47.53) than 60 kg ha^{-1} (40.22) of seed rate. 100 kg ha^{-1} (43.94) of seed rate was at par with 80 kg ha^{-1} seed rate. It depends on the ability of treatment to produce more grain yield than straw accumulation. Higher grain yield accounted for maximum harvest index. Similar result was reported by Kanouni and Fard (2013). Table-2 also revealed that significantly higher pods plant^{-1} produced by water primed seeds (44.44). It might be due to the fact that primed seeds establish earlier than non-primed seeds and the plant attains full growth in lesser time, taller plants and higher number of branches attained higher number of pods plant^{-1}. Similar results were recorded by Malvaya (2008) as he recorded significantly higher number of pods plant^{-1} (36.08). The maximum seed index (22.46 g) was obtained with water primed seeds. This might be due to seed development, cell division, translocation of sugar and starch from sink to source. The difference in seed index due to seed priming is confirmed by Shinde *et al.,* (2017).

Table.1 Effect of seed rate and seed priming on various growth attributes of chickpea

Treatments	Emergence count	Plant height (cm)	Number of branches plant^{-1}	Fresh weight plant^{-1} (g)	Dry weight plant^{-1} (g)
Seed rate (kg ha^{-1})					
60	15.33	47.79	31.46	39.42	19.79
80	17.11	50.82	28.56	38.03	17.82
100	21.22	55.54	22.91	35.36	14.32
SEm±	0.25	0.55	0.66	0.23	0.57
CD (0.5)	0.69	1.52	1.82	0.64	1.58
Seed priming					
Control	17.89	50.18	26.54	37.15	16.16
Water	17.44	52.79	29.58	38.53	18.32
NaCl	16.33	51.19	26.81	37.14	17.45
SEm±	0.49	0.53	0.77	0.55	0.26
CD (0.5)	1.43	1.52	2.21	1.58	0.77

Table.2 Effect of seed rate and seed priming on various yield attributes of chickpea

Treatments	Number of pods plant^{-1}	Seed index (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvestin dex (%)
Seed rate (kg ha^{-1})					
60	43.17	18.90	13.18	19.52	40.22
80	40.61	22.25	18.39	20.34	47.53
100	40.41	20.53	14.39	18.42	43.94
SEm±	0.88	0.42	0.37	0.87	1.40
CD (0.5)	2.45	1.15	1.03	NS	3.90
Seed priming					
Control	38.32	17.89	13.55	17.82	43.10
Water	44.44	22.46	17.00	20.17	45.66
NaCl	41.43	21.33	15.41	20.30	42.93
SEm±	1.30	0.32	0.50	0.55	1.12
CD (0.5)	3.75	0.91	1.43	1.60	NS

Higher seed yield was obtained from seed primed with water (17 q ha^{-1}). Seed priming results biosynthesis of plant hormones and components of various enzymes which play an important role in nucleic acid and protein synthesis confirmed by Malviya *et al.*, (2010) who reported that seed primed with water gave 25 per cent more grain yield than non-primed seeds. Seed priming with NaCl produced significantly highest straw yield (20.30 q ha^{-1}) as it was at par with water primed seeds (20.17 q ha^{-1}). Sethi*et al.*, (2015) and Hassanpouraghdam *et al.*, (2015) confirmed the results that seed priming with

GA_3 and water improved cell division and cell enlargement, resulted in maximum vegetative growth and straw yield. Effect of seed priming on harvest index was found non-significant. Ali and Kamel (2009) also reported in experimental finding that harvest index have no significant effect by seed priming.

The results of the present study showed that with the seed rate of 100 kg ha^{-1} the emergence count and plant height enhanced. On the other hand it may be concluded that the other growth parameters like number of branches, fresh weight and dry weight $plant^{-1}$ was increased with the use of 60 kg ha^{-1} seed rate. While the water primed treatments produced the maximum all plant growth parameters. In case of yield parameters, it may be concluded that number of pods $plant^{-1}$ was maximum with the seed rate of 60 kg ha^{-1} and the other yield parameters were enhanced with the use of 80 kg ha^{-1} seed rate except straw yield. On the other hand, with the utilization of water as a seed priming material, all the parameters of yield were increased except harvest index. The highest gross and net return and B:C ratio was found with the seed rate 80 kg ha^{-1} and water primed seeds.

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