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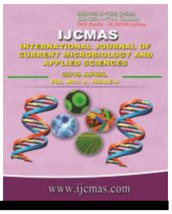

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Studies on Enhancing Seed Performance of Kabuli Chickpea

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ABSTRACT

The field and laboratory experiments were conducted to know the influence of pre-sowing treatment on plant growth, seed yield and quality in kabuli chickpea Cv. MNK-1. The results revealed that highest seed quality parameters were observed in seeds primed with GA_3 @ 50ppm + seed coating with *Trichoderma harzianum* @15g/kg while recorded better germination (97.33 %), root length (12.13 cm), shoot length (12.43 cm), SVI (2391) and less infection of *Aspergillus sp* (0.00) compared to untreated seeds (88.67 %, 11.48cm, 13.96cm, 2256, *Aspergillus niger*-6.00% and *Aspergillus flavus*-4.67 %), In the field study, highest test weight (48.46 g), number of pods/plant (18.53) were recorded in seeds primed with Gibberalic Acid @ 50 ppm + seed coating with *T. harzianum* @ 15 g / kg seed which is on-par with seeds treated with sprint @ 3g/kg (Carbendizium 25 %+ Mancozeb 50 %). However, the seeds treated with sprint @ 3g/kg (Carbendizium 25 %+ Mancozeb 50 %) recorded highest seed yield (22.55 q/ha) followed by Gibberalic Acid @ 50 ppm + seed coating with *T. harzianum* @ 15 g / kg (20.32 q/ha) due to low incidence of wilt as compared to un-primed seeds. Hence, for higher seed yield, chickpea seeds could be treated with sprint @ 3g/kg (Carbendizium 25 %+ Mancozeb 50 %).

Keywords

Kabuli Chickpea, Bio-fertilizers, Seed Priming, Seed quality, Seed yield

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Introduction

Globally, chickpea (*Cicer arietinum* L.) is the second most important legume crop after dry beans (Varshney *et al.,* 2013). Chickpea is grown in 54 countries with nearly 90 % of its area covered in developing countries. Notably, almost 80% of global chickpea is produced in Southern and South-Eastern Asia and India ranks first in the world, contributing 68 % of the global chickpea production accompanied by Australia (60 %), Turkey (47 %), Myanmar (42 %) and Ethiopia (35 %) (Gaur *et al.,* 2012). Worldwide chickpea production is estimated to be 11.30 million tons from 12.14 million ha area with an average productivity of 931 kg/ha. In India, it tops the list of pulse crops and is cultivated in 8.32 million ha, producing a total of 7.70 million tons with an average yield of 925.5 kg/ha (FAOSTAT 2014). From the nutrition perspective, chickpea seed contains 20–30 % crude protein, 40 % carbohydrate, and 3–6 % oil (Gil *et al.,* 1996). Besides, pulses supplemented diets are also good source of calcium, magnesium, potassium, phosphorus, iron and zinc (Ibrikci *et al.*, 2003).

Supply of good quality seeds is an important crucial point and it becomes imperative to evolve a strategy to produce quality seeds and make them available in time at a reasonable price to the farming community. There is ample evidence that poor crop stand establishment is a widespread constraint of crop production in developing countries, particularly in the marginal lands cultivated by poor resource farmers. Patchy plant stands are common, and yields are often reduced simply because there are not enough plants in the field. In addition, plants that do eventually emerge often grow slowly, and are highly susceptible to stresses such as drought, pests and diseases. Farmers can choose to re-sow, although this entails severe yield penalties and increased labour and financial costs, and there is evidence from our country that borrowing to pay for replacement seed can initiate or add to a spiral of indebtedness. Low, unstable yields are a major contributor to the fragile lives of poor farmers in marginal areas. One of the major constraints in chickpea cultivation is the limited availability of vigorous seeds at the time of sowing. This has become a major bottle neck in successful cultivation of chickpea as sowing of less viable seeds lead to poor crop stand establishment and thus resulting low yields. Lack of improved seed compels the farmers to procure locally available low potential seeds and suffer huge production losses, else leave the field fallow. This also affects the seed replacement rate and leads to occurrence of several seed borne diseases and insect pests. Farmers expect to have seed of improved cultivars with multiple resistances against *Helicoverpa*, wilt, dry root rot and terminal drought. These problems should receive the highest priority for chickpea improvement. The high cost of seed is another constraint in chickpea cultivation. Low-cost, low-risk interventions that increase and stabilize yields will have a large impact on the livelihoods of such farmers. At this juncture, seed priming technology plays a crucial and vital role in providing right seedling for better crop establishment even under adverse conditions.

Seed priming is a pre-sowing treatment that involves controlled hydration of seeds, sufficient to allow pre-germinative metabolic events to take place and to restrict radicle protrusion through the seed coat (Heydecker *et al.*, 1973). This technique has been used in many crops including chickpea to augment the speed of germination, mean germination time and seedling vigour etc., mainly under un-favourable environmental conditions like drought and stress. Hence, to address these issues an investigation was conducted to know the effect of pre-sowing treatments on seed quality, health, and yield in kabuli chickpea.

Materials and Methods

Laboratory and filed experiments were conducted to know the effect of seed enhancement technique on plant growth, seed yield and quality in kabuli chickpea from 2014-2015 to 2017-18 during *rabi* season. Freshly harvested seeds of chickpea (variety MNK-1) were dried to seed moisture below 9%. Chickpea seeds were subjected to pre-sowing treatments using various chemicals at ambient condition for four hours. After the completion of treatment period, the seeds were dried at room temperature.

Treatments details

T_1- Seed Priming with *Trichoderma harzianum* @ 1.5 %

T_2- Seed Priming with Vitavax Power @ 0.25 %

T_3- Seed Priming with Gibberalic Acid @ 50 ppm

T_4- Seed Priming with Gibberalic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15 g / kg seed

T_5- Seed Priming with Sodium Molybdate @ 500 ppm

T_6- Seed Priming with Sodium Molybdate @ 500 ppm + Seed coating with *T. harzianum* @ 15 g / kg seed

T_7- Seed Priming with leaf extract of *Lantana camara* @ 10 %

T_8- Seed hydration for 8 hrs

T_9- Chemical check – seed treatment with Bavistin @ 3g/ kg seed

T_{10}- Seed treatment with sprint @ 3g/ kg seed (Mancozeb 50 %+Carbendaizum 25%)

T_{11}- Control (un-primed seeds)

The standard germination test was done as per the ISTA rules (Anon., 2014) using between paper method. Four replicates of 100 seeds were allowed to germinate at temperature of 25°C. The germination counts were recorded on 8th day and per cent germination was expressed on normal seedling basis. Ten normal seedlings from each of the replications from the germination test were carefully removed on 8th day and used for measuring root and shoot length and the average root and shoot length was expressed in centimetre. Seedling vigour index was computed by using the formula suggested by Abdul-Baki and Anderson (1973).

Seedling Vigour Index (SVI)= Germination (%) x Seedling length (cm)

The seeds subjected to various pre-sowing treatments were sown in the field by adopting Randomized complete block design in three replications. Five plants at random from net plot area were selected and tagged in each plot for taking field observations. Five randomly selected plants were carefully uprooted from each plot with root system intact. The roots were washed in running tap water and nodules were detached carefully with forceps and number of nodules per plant was counted as average. The incidence of the disease in chickpea field was assessed by recording the number of plants showing wilt disease symptoms such as root rotting, yellowing of leaves, wilting of plants /m^2.

Present disease incidence =

$$\frac{\text{Number of plants showing wilt symptom x100}}{\text{Total number of plants}}$$

The number of filled pods present in five tagged plants was counted individually and the average was worked out and expressed as number of pods per pant at harvest. One hundred seeds in 8 replications were manually counted from seeds of five plants in each treatment and test weight was recorded by adopting ISTA procedure (Anon., 2014) and was expressed in grams. The crop was harvested when plants started drying, the colour of leaflets turned pale and pods to yellow colour. All the plants from net plot area of each treatment were uprooted, dried seeds were separated and weight was recorded separately in kilogram. On the basis of net plot seed yield, the seed yield per hectare was computed and expressed in quintals per hectare.

The data was statistically analysed and subject to analysis of variance by adapting the appropriate method as outlined by Panse and Sukhatme (1978). The critical differences were calculated at 1% and 5% level of probability wherever F test was found significant.

Results and Discussion

One of the most important symptoms of declining vigour is the slowing down of germination processes, often also accompanied by a wider scatter of the germination time of individual members of a seed population and to the farmer or grower both are thoroughly undesirable attributes. On the other hand, reducing both the time taken between sowing and germination and the time interval between the first and the last seed of a batch of germination would be agronomically highly welcome. Priming is one of the most simple and economical intervention practiced extensively to enhance the viability of seeds. In deciding the ability of a seed invigoration treatment by seed companies, the effect on seed yield and quality plays a crucial role.

Against this background, in order to assess the effect of pre-sowing treatments on seed quality, plant growth and seed yield, laboratory and filed experiments were conducted in kabuli chickpea. The results revealed that various pre-sowing treatments enhanced the germination and other seed quality parameters of chickpea. A perusal of data clearly indicated that, pre-sowing treatments differed in their effect on seed vigour and vigour related parameters. Among the several seed priming treatments tried, all the treatments were found to increase germination markedly ranging from 91.50 to 96.75 per cent over control (90.59 %). In majority of the results seed priming with gibberalic acid @ 50 ppm + seed coating with *T. harzianum* @ 15 g / kg seed followed by seed treatment with sprint @ 3g/ kg seed (Mancozeb 50 %+Carbendaizum 25 %) exhibited superior performance. The analysis of pooled data of four years indicates that highest seed vigour parameters were observed in seeds primed with GA_3 @ 50ppm + seed coating with *Trichoderma harzianum* @15g/kg [root length (14.53 cm), shoot length (10.21 cm) and seedling vigour index (2681)]. The untreated seeds recorded highest seed mycoflora (*Aspergillus niger-6.00 % and Aspergillus flavus-4.67 %*), and seeds primed with Gibberalic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15 g / kg seed treatment recorded less infection of *Aspergillus niger*, whereas, seeds were infected with *Aspergillus flavus* in all treatments.

Modern seed production systems require a high degree of precision in crop establishment. The need for high plant population densities and uniform plant stand requires seeds of high quality that will consistently produce rapid and uniform seedling emergence from each seed sown. Seed priming treatments significantly affected plant growth parameters viz. number of root nodules per plant, wilt incidence (%). Number of pods per plant, test weight and seed yield.

Seed productivity is widely limited by poor stand establishment and nutrient deficiencies. Particularly in drought prone areas, germination tends to be irregular and can extend over longer period of time (Bougne *et al.*, 2000). The resulting poor crop tends leave gaps in the canopy, which are rapidly filed by vigorously growing weeds with the onset of the short rainy season.

These weeds compete with the crop plants for light, water and limiting nutrients (Kroft and Van, 1993). Accelerating and homogenizing the germination process is a prerequisite for a good crop establishment process, the efficient use of resources and eventually to increase yields (Harris, 1996).

The number of pods per plant is the major yield components and determines the final seed yield; significantly contribute to the seed yield and represent reproductive efficacy of a seed crop. The statistically analyzed results showed seed priming treatments significantly influenced number of pods per plant and seed yield per hectare.

The need for high plant population density and uniform plant stand requires seeds of high quality that will consistently produce rapid and influence on uniform seedling emergence from each seed sown. The seeds primed with gibberalic acid @ 50 ppm + seed coating with *T. harzianum* @ 15 g / kg seed has recorded significantly highest number of pods per plant (28.75), test weight (52.67 g) which is on-par with seeds treated with sprint @ 3g/kg (Carbendizium 25 %+ Mancozeb 50 %)as compared to unprimed seeds. However, the seeds treated with sprint @ 3g/kg (Carbendizium 25 %+ Mancozeb 50 %) recorded highest seed yield (22.92 q/ha) followed by Gibberalic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15 g / kg (22.44 q/ha). In the present investigation significant variation due to seed priming and seed treatment with sprint, it is a combination of contact and systemic fungicide, having both curative and preventive activity.

Mixture partner Mancozeb is a contact action and preventive fungicide with multisite mode of action and It remains on the seed surface in treated seeds. It is fungitoxic when exposed to air, converted into isothiocynate, which inactivates the sulphahydral group of enzymes in fungi, causing disturbance in fungal enzyme functioning. Other mixture partner Carbendazim is systemic in action acts as preventive and curative. It acts by disrupting the spindle formation during cell division in fungi. Sprint is a broad-spectrum contact and systemic fungicide specially formulated for the control of seed and early soil borne diseases, Helps in early, uniform and healthy germination and also improves the seed germination and crop stand, addition to sprint fungicide supplies ‘Mn’ and ‘Zn’ nutrition to the plants (Anon, 2018).

In the field study, highest test weight (52.67 g), number of pods/plant (28.75) was recorded in seeds primed with Gibberalic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15 g / kg seed which is on-par with seeds treated with sprint @ 3g/kg (Carbendizium 25 %+ Mancozeb 50%). However, the seeds treated with sprint @ 3g/kg (Carbendizium 25%+ Mancozeb 50 %) recorded highest seed yield (22.92 q/ha) followed by Gibberalic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15 g / kg (22.44 q/ha) due to low incidence of wilt as compared to un-primed seeds.

Therefore based on above study, for increased production of quality seeds, chickpea seeds could be treated with sprint @ 3g/kg (Carbendizium 25 %+ Mancozeb 50 %) which is on-par with Gibberalic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15 g / kg seed.

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