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ARTICLE

Effect of seed coating substance (Genius Coat Disco Cereal AG L-439) on seed yield and yield component of chickpea (Cicer arietinum L.) in central highlands of Ethiopia

Tefsaye Geleta
Effect of seed coating substance (Genius Coat Disco Cereal AG L-439) on seed yield and yield component of chickpea (Cicer arietinum L.) in central highlands of Ethiopia

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Among the challenges of achieving increased chickpea production in Ethiopia is absence of seed quality enhancement technologies. The Genius Coat Disco Cereal AG L-439 is among the seed coating products produced by INCOTEC Company and introduced in our country. The current study was conducted to examine the efficacy of 'Genius Coat' on seed yield and to determine its effective dosage for chickpea seed production. The field experiment was conducted at Debre Zeit Agricultural Research Center and at Akaki and Minjar sub-sites in 2016. Pre-basic chickpea seed of Habru variety was used for the trial. The treatment consists of the company's recommendation rate (100%), 50% below and above the recommended rate, pure Apron Star and untreated control and laid out in RCBD with four replications. The analysis result for the collected data of yield and yield attributing parameters indicated that the tested seed coating substance at three different rates was found effective to increase the yield of chickpea. The yield advantage of 50% below the recommended rate was 0.58 tons/ha and 0.55 tons/ha over the control and standard check, respectively. Likewise, the recommended rate improved seed yield by 0.43 and 0.40 tons/ha when compared with the control and standard check, respectively. The simple combined correlation analysis result indicated that seed yield was positively, strongly and significantly associated with the stand count, days to maturity and biomass yield. Soil analysis result showed that the present seed coating substance had no significant effect on soil chemical properties. Therefore, Genius Coat at 50% below the recommended rate had a better yield advantage than the other rates and check treatments thus should be promoted.

Key words: Chickpea, genius coat, seed yield.

INTRODUCTION

Chickpea is the second major pulse crop next to common bean in the world with the total production of 12.33 million tons from 12.90 million ha of land (FAOSTAT, 2017). Ethiopia is considered as a secondary center of genetic...
diversity for chickpea and the wild relative of cultivated chickpea *Cicer cuneatum*, which is found in Tigray region of Ethiopia (Yadeta and Geletu, 2002; Kanouni et al., 2011). Among the most chickpea producing countries of the world, Ethiopia shares 3.26% next to India (68.7%), Turkey (8%), Pakistan (7%) and Myanmar (4.1%) (FAOSTAT, 2017).

Chickpea is among the most important pulse crops grown in Ethiopia dominantly in crop-livestock based farming systems of the Central, North and Northwest highlands of the country (CSA, 2013). The total area covered by chickpea in Ethiopia is estimated at 242,703.73 ha and from this, a corresponding mean annual production of 499,425.5 tons of chickpea is produced with an average national productivity of 2.058 tons (CSA, 2017/2018) where the potential yield is more than 5 tons. It is a highly nutritious grain legume and one of the cheapest sources of energy protein with soluble and insoluble fiber (Pavanshinde et al., 2015). It is a readily available source of protein (19%), carbohydrates (60%), and minerals (phosphorus, calcium, and iron) (Ibrikci et al., 2003). It also returns a significant amount of residue nitrogen to the soil, adds organic matter and improves fertility (Pande et al., 2005).

However, a number of biotic and abiotic factors constrain chickpea production in the country. Among the biotic factors, ascochyta blight and fusarium wilt are the major diseases of chickpea while African ball worm and cut worms are the most important insect pests of the crop (Kimber et al., 2006; Dereje Gorfu et al., 2012). Under such circumstances, a possibility of increasing the existing yield is inadequate. In order to tackle these problems and increase the productivity of the crop, good quality seeds need to be made available to farmers through different seed quality enhancement techniques like pre-sowing hydration treatment, seed coating and pelleting techniques.

The Genius Coat is among the seed coating products produced by INCOTEC Company in Netherlands and introduced in Ethiopia. Its active ingredient boosts crop nutrition and stimulates root development by nurturing the seed; and a chain reaction is triggered that reinforces the entire growth period, ultimately maximizing yield. However, the importance of this substance was not studied so far in Ethiopia. Therefore, this experiment was conducted with the objective of examining the efficacy of Genius Coat Disco Cereal AG L-439 on yield and yield component of chickpea, and to determine its effective dosage for chickpea seed production.

**RESULTS AND DISCUSSION**

The effects of different rates of seed coating substance, when applied on seeds, on the yield and yield components of chickpea were investigated in comparison with standard check and untreated control. Combined mean analysis for measured yield and yield related parameters are indicated in Table 2. The combined analysis of variance across locations showed significant (P≤0.05) difference among the tested treatments for first stand count, stand count at harvest, days to flowering, plant height, biomass yield, seed yield, and 100-seed weight. The rest of the parameters tested, however, were not statistically different (Table 2). Highest mean number of plants per plot (during early stand count) was recorded from seeds treated with genius coat 50% below the recommended rate, while the lowest value was obtained from the untreated control treatment, though they were not statistically different. At harvest, plots treated with the test product at all rate and the standard check gave significantly (P ≤ 0.05) higher number of plants/plot when compared with the untreated control treatment. This indicates that seed treatment resulted in good plant establishment where the test product showed better effect, though not significantly (P ≤ 0.05) different from the standard check. The tallest plant (45.05 cm) was recorded from the untreated control while the lowest plant height (42.38 cm) was recorded from 100% rate of genius.
coat substance. Taken together, there is significant difference (P ≤ 0.05) among the treatments, and that untreated seeds and seeds treated with standard check produced higher plant height than the ones treated with test product (Table 2).

The effect of seed coating substance at different concentration rates on biomass yield was significant (P ≤ 0.05) (Table 2). Significantly (P ≤ 0.05) higher biomass yield was obtained from the highest rate of the test product compared to the untreated check. Seed coating treatments generally produced better biomass compared to the untreated control.

Table 2 depicts the means of chickpea seed yield as influenced by application of test product with different rates. The analysis of variance indicated significant (P ≤ 0.05) seed yield differences (2.59 to 3.17 tons/ha) due to the seed coating substance. The highest seed yield (3.17 tons/ha) was obtained from seeds treated with 50% below the recommended rate of the test product followed by yield (3.02 tons/ha) from seed treated with (100%) recommended rate. The lowest yield (2.59 tons/ha) was obtained from the control check. Results of the experiment revealed that the candidate seed coating substance, Genius Coat Disco Cereal AG L-439, at the rate of 3.75 and 7.5 ml per kilogram seed of chickpea (50% below the recommended rate) significantly (P ≤ 0.05) improved seed yield. Similar with present result, Bhatnagar and Porwal (2010) also stated that, the groundnut seeds coated with polymer recorded higher number of pods, seed weight, pod yield and dry matter. Shakuntala et al. (2010) concluded that the higher seed yield and quality of sunflower was obtained from coated seed experiment.

Table 1. Treatment details.

<table>
<thead>
<tr>
<th>Treatment Code</th>
<th>Treatment description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% BRR of TP</td>
<td>3.75ml Genius Coat Disco Cereal AG L-439 + 2.5g Apronstar 42WS + 9ml water per kilogram of seed</td>
</tr>
<tr>
<td>RR of TP</td>
<td>7.5ml Genius Coat Disco Cereal AG L-439 + 2.5g Apronstar 42WS + 5ml water per kilogram of seed</td>
</tr>
<tr>
<td>50% ARR of TP</td>
<td>11.25ml Genius Coat Disco Cereal AG L-439 + 2.5g Apronstar 42WS + 1ml water per kilogram of seed</td>
</tr>
<tr>
<td>Apronstar (Standard check)</td>
<td>2.5g Apronstar 42WS + 10ml water per kilogram of seed</td>
</tr>
<tr>
<td>Control</td>
<td>Untreated seed</td>
</tr>
</tbody>
</table>

*RR=Recommended rate, BRR= below recommended rate, ARR=Above recommended rate, TP=Test product (Genius Coat Disco Cereal AG L-439).

Table 2. Mean comparison of genius coat on crop phenology, yield and yield related parameters of chickpea grown at Debre Zeit, Minjar and Akaki in 2016.

| Treatments                      | DE  | EStdC | HStdC | DF  | DM  | PH   | Pd/pl | Sd/po | BM   | SY   | HI   | HSW  |
|--------------------------------|-----|-------|-------|-----|-----|------|-------|-------|------|------|------|------|------|
| 50% BRR of TP                  | 11.41| 84.75b| 72.50b| 49.33| 103.91| 42.91bc| 35.65 | 1.17 | 7.08ab| 3.17a| 0.44 | 31.19a|
| RR of TP                       | 10.67| 82.92b| 73.67b| 50.17| 103.83| 42.38c| 37.22 | 1.13 | 7.38ab| 3.02a| 0.41 | 30.55ab|
| 50% ARR of TP                  | 10.75| 78.25b| 71.67a| 49.92| 104.41| 43.40abcd| 35.08 | 1.12 | 7.87ab| 2.86ab| 0.40 | 30.93a|
| Apronstar (Standard check)     | 11.25| 77.33b| 68.50b| 49.67| 104.33| 44.60abc| 36.37 | 1.16 | 7.06ab| 2.62b| 0.39 | 30.71ab|
| Control                        | 11.08| 67.08b| 56.83b| 50.50| 104.50| 45.05ab| 36.73 | 1.12 | 6.41b | 2.59b| 0.42 | 30.12b |
| LSD (5%)                       | 1.04 | 9.75  | 10.36 | 1.54 | 3.14 | 2.09 | 5.29  | 0.07 | 1.03 | 0.39 | 0.07 | 0.76
| CV (%)                         | 11.49| 15.15 | 18.33 | 3.75 | 3.66 | 5.83 | 17.75 | 7.85 | 17.37| 16.7 | 21.33 | 3.02|

*RR=Recommended rate, BRR= below recommended rate, ARR=Above recommended rate, TP=Test product (Genius Coat Disco Cereal AG L-439). **DE=Days to emergence, EStdC=Early stand count, HStdC=Stand count at harvest, DF=Days to flowering, DM=Days to maturity, PH=Plant height, Pd/pl=Number of pod per plant, Sd/po=Number of seed per pod, BM=Biomass yield, SY=Seed yield, HI=Harvest index, HSW=100 seed weight. Means followed by the same letter along column are not significantly different from each other at 5% probability.
Table 3. Mean values of soils chemical characteristics at the three experimental sites (Debre Zeit, Minjar and Akaki) during the 2016, before planting and after harvest.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Parameter</th>
<th>TN%</th>
<th>OM%</th>
<th>pH</th>
<th>Exchangeable K (cmol(+)/kg)</th>
<th>Available P (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>TN%</td>
<td>0.1034</td>
<td>3.45</td>
<td>7.14a</td>
<td>1.67a</td>
<td>11.11b</td>
</tr>
<tr>
<td>100%</td>
<td>OM%</td>
<td>0.1089</td>
<td>3.64</td>
<td>7.11a</td>
<td>1.73a</td>
<td>10.93b</td>
</tr>
<tr>
<td>150%</td>
<td>pH</td>
<td>0.101</td>
<td>3.87</td>
<td>7.10a</td>
<td>1.61a</td>
<td>10.82b</td>
</tr>
<tr>
<td>Before planting</td>
<td></td>
<td>0.1086</td>
<td>3.65</td>
<td>6.92b</td>
<td>1.28b</td>
<td>14.5a</td>
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<tr>
<td>Standard check</td>
<td>Exchangeable K</td>
<td>0.1024</td>
<td>3.58</td>
<td>7.15a</td>
<td>1.66a</td>
<td>10.92b</td>
</tr>
<tr>
<td>Local check</td>
<td>Available P</td>
<td>0.1024</td>
<td>3.77</td>
<td>7.13a</td>
<td>1.70a</td>
<td>11.04b</td>
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<tr>
<td>LSD (5%)</td>
<td>pH</td>
<td>0.013</td>
<td>0.44</td>
<td>0.08</td>
<td>0.14</td>
<td>1.34</td>
</tr>
<tr>
<td>CV (%)</td>
<td></td>
<td>15.56</td>
<td>15.75</td>
<td>1.29</td>
<td>10.39</td>
<td>14.19</td>
</tr>
</tbody>
</table>

TN=total nitrogen, OM=Organic matter, K=potassium, P=phosphorus, ppm=parts per million, cmol(+)/kg=cent mole charge per kilogram of soil. Means followed by the same letter along column are not significantly different from each other at 5% probability level.

Seed weight is an important yield determining component. Analysis of variance revealed that effect of the treatment combinations significantly (P ≤ 0.05) affected hundred seed weight of chickpea. Significantly (P ≤ 0.05) highest mean hundred seed weight was obtained from seeds treated with 50% below the recommended rate of test products, and the lowest value was obtained from untreated/control seeds (Table 2).

Soil analysis

Soil analysis was conducted for the composite sample collected from the experimental sites (Debre Zeit, Minjar and Akaki) before planting, and plot based sample after harvest, to assess the change in the major soil chemical properties (N, OM, pH, K and P) at Debre Zeit Soil Laboratory. The analysis of variance revealed that soil pH, exchangeable K and available P were significantly (P ≤ 0.05) decreased by the treatments when compared with the pre-planting soil analysis result. On the contrary, total N and organic matter content were not affected by the treatment combinations (Table 3). High p and PH and low K were obtained from soil sample collected before planting compared to the other treatments. Soil pH has increased after harvest for all tested treatments as compared to pre-planting result (Table 3). As can be seen from the Table 3, the seed coating substance (Genius Coat Disco Cereal AG L-439) at all rates, standard check and control treatments did not produce any significant (P ≤ 0.05) effect on soil chemical properties.

Association of seed yield to other parameters

Simple combined correlation analysis was performed for the measured variables of phenological, yield and yield related parameters. The results of the simple correlation between seed yield and yield components of chickpea are presented in Table 4. The results indicated that, seed yield was positively and significantly associated with the first stand count (r=0.62**), stand count at harvest (r=0.54**), days to maturity (r=0.67**) and biomass yield (r=0.64**) for the tested treatments (Table 4). On the other hand, seed yield was negatively correlated with days to flowering, plant height and seed per pod but not statistically significant with the exception of plant height. Days to emergence and number of pods per plant were positively but not significantly correlated with seed yield. The present result is in line with the work of Rahimi Azar et al. (2013) who concluded that seed yield was positively correlated with number of pods per plant, biomass yield, seed weight and harvest index.

CONCLUSION AND RECOMMENDATION

The results of analysis for the collected field data of yield and yield attributing parameters indicated that the tested seed coating substance named Genius Coat Disco Cereal AG L-439, at three different rates (50, 100 and 150%) was found effective to increase the yield of chickpea. The yield advantage of 50% rate was 0.58 and 0.55 tons/ha over the control and standard check, respectively. Likewise, the recommended rate (100%) improved seed yield by 0.43 and 0.40 tons/ha when compared with the control and standard check (untreated seed and dressed by Apron star), respectively. The simple combined correlation analysis results indicated that seed yield was positively, strongly and significantly associated with the first stand count, stand count at harvest, days to maturity and biomass yield. Based on the current results, it is possible to suggest that any
positive increase in such traits will significantly improve seed yield of chickpea. Soil analysis results showed that the present seed coating substance (Genius Coat Disco Cereal AG L-439), at all tested rates, had no significant effect on soil chemical properties. Therefore, Genius Coat Disco Cereal AG L-439 at 50% below the recommended rate had yield advantage over the other rates, and check treatments that shall be promoted since it is capable of improving the production and productivity of the crop, and hence the income and livelihood of chickpea producers.

**CONFLICT OF INTERESTS**

The author has not declared any conflict of interests.

**REFERENCES**


<table>
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<th>HSDc</th>
<th>DF</th>
<th>DM</th>
<th>PH</th>
<th>Pod/p</th>
<th>Seed/po</th>
<th>BM</th>
<th>SY</th>
<th>HI</th>
<th>HKW</th>
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<td>0.09ns</td>
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</tr>
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<td>-0.43**</td>
</tr>
</tbody>
</table>

ns = Not significant at P<0.05; ** = Significant at P<0.05 and 0.01 respectively. DE=days to emergence, FSdC=first stand count, HSDc=stand count at harvest, DF=days to flowering, DM=days to maturity, PH=plant height, Pod/p=number of pod per plant, Seed/po=number of seed per pod, BM=biomass yield, SY=seed yield, HI=harvest index, HSW=100 seed weight. Means followed by the same letter along column are not significantly different from each other at 5% probability level.