Vol. 11(1), pp. 1-5, February 2019
DOI: 10.5897/JABSD2018.0332
Article Number: 9E57C5360240
ISSN: 2141-2340

http://www.academicjournals.org/JABSD

ACADEMIC JOURNALS
expand your knowledge

Journal of Agricultural Biotechnology and Sustainable Development

Full Length Research Paper

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

Tesfaye Geleta

Ethiopian Institute of Agricultural Research, Debre Zeit Agricultural Research Center, P. O. Box 32, Debre Zeit, Ethiopia.

Received 2 October, 2018; Accepted 7 February, 2019

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

E-mail: tesfayegeletaga@gmail.com.

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 fusaruim wilts 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.

MATERIALS AND METHODS

The field experiment was conducted in 2016 main cropping season at Debre Zeit Agricultural Research Center main station and at Akaki and Minjar sub-sites which represent mid, high and low altitude areas respectively. Pre-basic chickpea seed of Habru variety sourced from Debre Zeit Agricultural Research Center of chickpea improvement program was used for the trial. The seed was treated on July 2016 to be sown from August to September 2016 based on the agro-ecology of the stations. The treatments were based on dosage of Genius Coat Disco Cereal AG L-439, where the company's recommendation rate (100%), 50% below and above the recommended rate, all rates in combination with Apronstar were compared with pure Apron Star (standard check) and untreated control. Both test product and standard check seed coating substances confirmed that they are safe for human being and environment. Description of the treatments is depicted in Table 1.

The experiment was laid out in randomized complete block design with four replications. The plot size was 1.2 m × 3 m (3.6 m^2). The space between blocks, plots, rows and plant was 1.5, 0.5, 0.3 and 0.1 m, respectively. All agronomic practices were applied as per the recommendations for the crop. The recommended seed rate (147 kg/ha) was used and planting was done manually. Soil samples were collected from the experimental sites and analysis was made on soil N, OM, pH, K and P using macro-Kjeldhal, wakly black, pH meter with 1:2.5 soil water suspension, flame photometer and Olsen methods respectively. The analysis for samples collected before planting was made on composite sample. For the samples collected after harvest, the analyses, however, was undertaken on samples collected from each plot. Pertinent yield and yield component data were collected. The data obtained from the field experiment were analyzed using SAS soft-ware version 9:0. Mean comparison was made using least significant difference (LSD) test at 5% level of significance.

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 ($P \leq 0.05$) 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 ($P \leq 0.05$) 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 ($P \leq 0.05$) 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

Table 1. Treatment details.

Treatment Code	Treatment description
50% BRR of TP	3.75ml Genius Coat Disco Cereal AG L-439 + 2.5g Apronstar 42WS + 9ml water per kilo gram of seed
RR of TP	7.5ml Genius Coat Disco Cereal AG L-439 + 2.5g Apronstar 42WS + 5ml water per kilo gram of seed
50% ARR of TP	11.25ml Genius Coat Disco Cereal AG L-439 + 2.5g Apronstar 42WS + 1ml water per kilo gram of seed
Apronstar (Standard check)	2.5g Apronstar 42WS + 10ml water per kilo gram of seed
Control	Untreated seed

*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	Parameter											
	DE	EStdC	HStdC	DF	DM	PH	Pd/pl	Sd/po	BM	SY	HI	HSW
50% BRR of TP	11.41	84.75^{a}	72.50^{a}	49.33	103.91	42.91^{bc}	35.65	1.17	7.08^{ab}	3.17^{a}	0.44	31.19^{a}
RR of TP	10.67	82.92^{a}	73.67^{a}	50.17	103.83	42.38^{c}	37.22	1.13	7.38^{ab}	3.02^{a}	0.41	30.55^{ab}
50% ARR of TP	10.75	78.25^{a}	71.67^{a}	49.92	104.41	43.40^{abc}	35.08	1.12	7.87^{a}	2.86^{ab}	0.40	30.93^{a}
Apronstar (Standard check)	11.25	77.33^{a}	68.50^{a}	49.67	104.33	44.60^{ab}	36.37	1.16	7.08^{ab}	2.62^{b}	0.39	30.71^{ab}
Control	11.08	67.08^{b}	56.83^{b}	50.50	104.50	45.05^{a}	36.73	1.12	6.41^{b}	2.59^{b}	0.42	30.12^{b}
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.

coat substance. Taken together, there is significant difference ($P \leq 0.05$) 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 ($P \leq 0.05$) (Table 2). Significantly ($P \leq 0.05$) 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 ($P \leq 0.05$) 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 ($P \leq 0.05$) improved seed yield. Similar with present result, Bhatnagar and Porwal (1990) reported that higher chickpea seed yield was recorded from polymer seed coating experiment. Chikkanna et al. (2000) 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 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.

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

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

Table 4. Pearson's simple combined correlation coefficients for phenological, yield and yield attributing parameters of chickpea seed coating substance tested at Debre Zeit, Minjar and Akaki during 2016 cropping season.

	DE	FSdC	HSdC	DF	DM	PH	Pod/p	Seed/po	BM	SY	HI	HKW
DE	1											
FSdC	0.39**	1										
HSdC	0.41**	0.95**	1									
DF	0.23ns	0.02ns	0.09ns	1								
DM	0.46**	0.75**	0.78**	0.11ns	1							
PH	0.04ns	-0.16ns	-0.02ns	0.35*	-0.04ns	1						
Pod/p	-0.03ns	-0.13ns	-0.14ns	0.28*	-0.03ns	-0.06ns	1					
Seed/p	-0.17ns	-0.18ns	-0.23ns	0.07ns	-0.38*	-0.04ns	-0.05ns	1				
BM	0.13ns	0.32*	0.24ns	-0.17ns	0.39**	-0.54**	0.36*	-0.14ns	1			
SY	0.23ns	0.62**	0.54**	-0.16ns	0.67**	-0.40*	0.01ns	-0.24ns	0.64**	1		
HI	-0.05ns	0.07ns	0.10ns	-0.03ns	0.05ns	0.27*	-0.42**	-0.07ns	-0.56**	0.18ns	1	
HKW	-0.24ns	-0.28*	-0.43**	-0.23ns	-0.37*	-0.46**	0.34*	0.08ns	0.50**	0.07ns	-0.51**	1

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.

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

Bhatnagar GS, Porwal MK (1990), Effect of organic polymeric compounds on the seed yield of chickpea (*Cicerarietinum*L.). International Journal of Tropical Agriculture 8(3):217-219.

Chikkanna CS, Timmegouda, Ramesh R (2000), Hydrophilic polymer seed treatment on seed quality and yield in finger millet, cowpea and groundnut. Seeds and Farms 85:39-45.

Central Statistical Agency (CSA) (2013). Agricultural sample survey report on area and production of crops private peasant holdings, meher season.pp 2-4. September–December 2012/2013 Volume I, Statistical Bulletin No. 388, Addis Ababa, Ethiopia.

Central Statistical Agency (CSA) (2017/2018). Agricultural sample survey report on area and production of crops private peasant holdings, meher season. P 19. April 2018 Volume I, Statistical Bulletin No. 586, Addis Ababa, Ethiopia.

Dereje G, Amare A, Frew M, Yonas N (2012). Seed health testing in seed systems in Ethiopia. In Adefris T/wold, AsnakeFikre, DawitAlemu, Lemma Desalegn and AbebeKirub (eds.) The Defining moments in Ethiopian Seed System. EIAR, Addis Ababa, Ethiopia. pp. 169-180.

Food and Agriculture Organization (FAO) (2017). Available online: http://faostat.fao.org/site/567/DesktopDefault.aspx (accessed on 10 January 2017).

Gaur MP, Aravind KJ, Rajeev KV (2012). A review of impact of Genomic technologies on chickpea breeding strategies. Agronomy 2:200-203.

Ibrikci H, Knewtson S, Grusak MA (2003). Chickpea leaves as vegetable green for humans: Evolution of mineral composition. Journal Science Food Agriculture 83:945-950.

Kanouni H, Taleei A, Okhovat M (2011). Aschchyta blight (Ascochytarabiei (Pass.) Lab.) of Chickpea (*Cicerarietinum* L.): Breeding strategies for resistance. International Journal of plant Breeding and Genetics 5:1-22.

Kimber RBE, Scott ES, Ramsey MD (2006). Factors influencing transmission of *Didymellarabiei* (ascochyta blight) from inoculated seed of chickpea under controlled conditions. European Journal of Plant Pathology 114:175-184.

Pande S, Siddique KM, Kishore GK, Bayaa B, Gaur PM, Gowda CLL, Bretaga TW, Crouch JH (2005). Ascochyta blight of chickpea (Cicerarietinium L.): a review of biology, pathogenicity and disease management. Australian Journal of Agricultural Research 56:1-4.

Pavanshinde SR, Doddagoudar SN, Vasudevan S, Patil B, konda CR (2015). Standardization of seed coating polymer in chickpea. Karnataka Journal of Agricultural Science 28(3):412-413.

Rahimi MA, Javanmard A, Shekari F, Pourmohammad A, .Esfandyari E (2013). Evaluation of Yield and Yield Components Chickpea (*CicerArietinum* L.) in Intercropping With Spring Barley (*HordeumVulgare* L.) CercetariAgronomiceîn Moldova 4(156).

Shakuntala NM, Vyakaranahal BS, Shankergoud I, Deshpande VK, Pujari BT, Nadaf HL (2010). Effect of Seed Polymer Coating on Growth and Yield of Sunflower Hybrid Rsfh-130. Karnataka Journal of Agricultural Science 23(5).

Yadeta A, Geletu B (2002). Evaluation of Ethiopian chickpea landraces for tolerance to drought.Genetic Resources and Crop Evolution 49:557-564.