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Effect of seed priming on field emergence, plant growth, seed yield and disease incidence in Kabuli chickpea (*Cicer arietinum* L.) varieties

Pavan Shinde and Ravi Hunje

Abstract
Field experiment was carried out at Water and Land Use Management Institute (WALMI) Farm, National Seed Project (Crops), Seed Unit, University of Agricultural Sciences, Dharwad during 2016-17 and 2017-18. The experiment was laid in split plot design with three replications involving two kabuli chickpea varieties and nine seed priming treatments. The results revealed that seed priming with Sprint (Mancozeb 50% + Carbendazim 25% WS) @ 2 g per kg of seed (T_9) recorded significantly highest field emergence, plant growth, plant population, seed yield and lower disease incidence as compared to other treatments and control.

Keywords: BG1105, Kabuli chickpea, MNK-1, priming, sprint

Introduction
Chickpea (*Cicer arietinum* L.) is a old world pulse crop commonly known as bengalgram, garbanzo bean, gram, chana, kadlee and is the third most important pulse crop in the world after beans and peas. Chickpea is popularly cultivated in sub-tropical and semi-arid to warm temperate regions under dry season. Chickpea is valued for its nutritive seed composition with high protein content and used increasingly as a substitute for animal protein. It also accounts for efficient soil enrichment by symbiotic nitrogen fixation and it has ability to meet more than 70 per cent of its nitrogen requirement from symbiotic nitrogen fixation, besides being drought tolerant.

Chickpea is classified based on seed size, shape and colour. Two main types of chickpea cultivars grown globally are Kabuli and Desi, representing two diverse gene pools. Where, white seeded 'Kabuli chickpea' being grown in Northern parts and brown seeded 'Desi' type grown in Southern parts of India. India is the largest producer of chickpea in Asia contributing over 70 per cent of the world production with an area of 86.80 lakh hectare and with a production of 80.90 lakh tonnes and productivity of 932 kg per hectare (Anon., 2017) [2]. Globally and nationally the area, production and productivity of Kabuli type is very low as compared to Desi type chickpea. However, world of chickpea is predominanted by Desi type which accounts 80 per cent of production as compared to Kabuli type which accounts to 20 per cent of production. Poor germination and low seed viability are among the serious problems limiting the production of Kabuli chickpea. The per unit performance productivity of kabuli chickpea is low as compared to desi chickpea, this may be mainly due to smooth/fragile seed coat, the percent of tannin content (which act as primary defense mechanism from biotic and abiotic conditions) in seed coat more prone to fungal inoculums present in the soil of preceding groundnut and soybean crop. Hence, an attempt was made to investigate the best seed priming treatment for better field emergence and disease control. Seed priming proved positive correlation with field emergence. The use of chemical fungicide/ combiproducts of insecticide play a very significant role to control the inoculums present around the seed rhizosphere and improve considerable tolerance against biotic and abiotic stress.

The use of high quality seeds is essential to establish a suitable population in fields, giving better financial results (Krzyzanowski *et al*., 1993) [7]. Seed priming is a presowing treatment which leads to a physiological state that enables seed to germinate more efficiently. The majority of seed treatments are based on seed imbibition allowing the seeds to go through the first reversible stage of germination but do not allow protrusion through the seed coat. During subsequent germination, primed seeds exhibit faster and more synchronized germination and

young seedlings are often more vigorous and resistant to abiotic stresses than seedling obtained from unprimed seeds resulting in increased production and productivity (Heydecker *et al*., 1973) [6]. Thus, development of simple, feasible and viable technology to improve seedling vigour and seedling establishment of crops under varied environmental conditions is of utmost important. Looking to the positive effects of priming a study was conducted to know the effect of seed priming on field emergence, plant growth, seed yield and disease incidence in kabuli chickpea varieties.

Materials and Methods

The experiment consisted of two varieties *viz.,* V_1 (BG1105) and V_2 (MNK-1) and nine seed priming treatments *viz.,* T_1: Control, T_2: Hydro priming, T_3: Calcium chloride @ 2%, T_4: $ZnSO_4$ @ 2 g per kg of seed, T_5: Cowurine @ 25%, T_6: Panchagavya @ 3%, T_7: Custard apple leaf extract @ 3%, T_8: Rhizobium (GR-2) @ 4 ml per kg of seed and T_9: Sprint (Mancozeb 50% + Carbendazim 25% WS) @ 2g per kg of seed. The field experiment was conducted at Water and Land Management Institute (WALMI) farm, Dharwad during *rabi* 2016 and 2017 in split plot design with three replications.

Procedure for preparation of seed priming: Different seed priming treatments *viz.,* Calcium chloride, Zinc sulphate, Cowurine, Panchagavya, Custard apple leaf extract, Rhizobium (GR-2), Sprint (Mancozeb 50% + Carbendazim 25% WS) were added to sterilized distilled water to get the desired per cent of solution as per treatment concentrations and used for soaking the seeds as per the required weight by volume ratio of seed to solution (1:2) and soaked for four hours. Then, the seeds were air dried under shade and used for sowing in field. Whereas for control no treatment was imposed and for hydropriming the seeds were soaked for four hours in weight by volume ratio of seed to solution (1:2). The biometric observations on growth parameters were recorded at different growth stages. For recording various growth parameters five plants at random from net plot area were selected and tagged in each plot for taking observations while, the assessment of *Fusarium* wilt incidence was conducted at weekly intervals. Incidence was assessed by counting the number of plants over total number of plants in the field and expressed as percentage of wilt incidence.

$$\text{Wilt incidence (\%)} = \frac{\text{Number of plants infected}}{\text{Total number of plants}} \times 100$$

Statistical analysis was done as per the procedure described by Gomez and Gomez (2010) [5].

Results and Discussion

Varietal performance of Kabuli chickpea

The field emergence, plant growth, seed yield and wilt incidence were greatly influenced by genetic makeup of the varieties. In addition to it several biotic, abiotic, agronomic and management practices. Varietal differences with respect to field performance have been noticed in Kabuli chickpea during 2016 and 2017. The results of pooled data revealed that variety BG1105 (V1) registered significantly highest field emergence (81.59%) (Table 1), plant height (22.38, 38.29 and 43.19 cm at 30 DAS, 60 DAS and harvest, respectively) (Table 2), chlorophyll (42.96, 48.11 and 45.94 SPAD value at 30, 60 and 75 DAS) (Table 3), seed yield per hectare (13.00 q) (Table 4) and lower wilt incidence (8.41%) (Table 4) during 2016, 2017 and pooled data as compared to variety MNK-1 (80.33%; 20.19, 33.41 and 37.21 cm; 38.36, 42.49 and 40.05 SPAD values; 11.72 q; and 9.67%, respectively). The probable reason for higher field emergence in BG1105 variety may be due to smaller seed size, which might have taken lesser time to complete the early phase of seed germination leading to early emergence and protrusion of root and shoot with autotrophic activity by harnessing sunlight for photosynthesis at early stage. Similarly lower rate of wilt incidence may be due to the smaller surface which may help to escape from fungal pathogens present around root zone when compared to MNK-1 which has bigger seed surface, which is said to have maximum chances of seed damage with further invasion of fungal pathogen to seed during early germination phase. From these results, it was found that both varieties differed significantly for field emergence, growth parameters, seed yield and wilt incidence due to their genetic differences. Such differential genotypic response on field emergence and growth parameters are also in conformity with the reports of Merwade (2000) [8], Gnyandev (2009) [4] and Sushma (2013) [10] in chickpea.

Effect of seed priming

Seed priming has greater impact on field emergence, growth, seed yield and wilt incidence during 2016, 2017 year and pooled data. The field emergence and plant height differed significantly due to seed priming. The results pooled data revealed that significantly higher field emergence (98.21%) (Table 1) and plant height (27.51, 43.28 and 48.01 cm at 30, 60 DAS and at harvest, respectively) (Table2) due to seed priming with T_9 [Sprint (Mancozeb 50% + Carbendazim 25% WS) @ 2 g/kg of seed] as compared to control (86.74%; 20.90, 37.08 and 42.34 cm, respectively). However, T_9 was followed by T_4 ($ZnSO_4$ @ 2 g/kg of seed), T_3 (Calcium chloride @ 2%) T_6 (Panchagavya @ 3%) T_7 (Custard apple leaf extract @ 3%), T_8 (Rhizobium (GR-2) @ 4 ml/kg of seed), T_5 (Cowurine @ 25%) and T_2 (Hydro priming). The increase in field emergence per cent and plant might be due to seed priming with sprint, which is composed of contact and systematic fungicide which mainly helps in protection of seed (as the Kabuli chickpea seeds have very soft, delicate seed coat that are prone to damage by both biotic and abiotic factors) from invading and survival of wide range of fungal pathogens around rhizospere throughout the crop growth period and provides a favorable condition by enhancing sufficient nutrient uptake from rhizosphere through better root system. In addition, sprint is a composed of micronutrients *viz.*, Zinc (Zn) and Manganese (Mn), where Zn helps in the synthesis of tryptophan which is a precursor of Indole acetic acid; it also has an active role in the production of an essential growth hormone *viz.*, auxin which may trigger the metabolic activity of enzymes required for seed germination leading to rapid cell division, cell enlargement and radical emergence leading to formation of effective root system with early and uniform field emergence and better plant growth (Anon, 2018) [3]. Similar effect of seed treatment with carbendizium (0.1%) in chickpea increased germination percentage and seedling vigour index, but also reduced the disease incidence and seedling mortality (Mailem *et al.*, 2015) [12] while, Padamini *et al*. (2015) [9] found that combined seed treatment (Vitavax + *Trichoderma harzianum*) were superior in terms of better seedling emergence, lower mortality and higher seed yield as compared to other seed treatments in chickpea. These results are in conformation with Anitha *et al.* (2013) [1] in Soybean and Xalxo *et al*. (2007) [11] in chickpea.

Seed priming had significant effect on chlorophyll content during 2016 and 2017. From the results of pooled data, significantly highest chlorophyll content (SPAD value) at 30 (50.59), 60 (55.76) and 75 days after sowing (DAS) (53.45) (Table 3) was recorded due to seed priming with T_9 [Sprint (Mancozeb 50% + Carbendazim 25% WS) @ 2 g per kg of seed] as compared to other treatments and control (42.12, 47.57 and 44.07, respectively) this might be due to presence of Zinc in sprint which might have played very important role in plant metabolism by influencing the activities of hydrogenase and carbonic anhydrase, stabilization of ribosomal fractions and synthesis of cytochrome helpful in chlorophyll synthesis. Further, Mn present in sprint might have played some role in maintenance of chloroplast membrane structure, which occurs in activation of chloroplast RNA polymerase and splitting of water and the presence of mangano protein catalyzes the oxygen evolution which indicates the higher rate of photosynthetic activity leading to higher chlorophyll content and vegetative growth of plant. These results are in conformation with Anitha *et al.* (2013) [1] in Soybean and Xalxo *et al.* (2007) [11] and Padamini *et al.* (2015) [9] in chickpea.

The results of pooled data, significantly higher seed yield per hectare (16.59 q) (Table 4) was recorded in T_9 [Sprint (Mancozeb 50% + Carbendazim 25% WS) @ 2 g per kg of seed] as compared to other treatments and control (T_1) (12.09 q, respectively), this may be due to seed priming which improves rRNA integrity, repairing of cell constitutes and increased activity of protein synthesis to permit subsequent germination resulting in early seed germination, uniform plant stand and exposure of these plants for proper harness of sunlight, for photosynthesis and its translocation of food metabolites to different growing parts and leading to better vegetative growth with increased number of primary and secondary branches per plant which add together for production of more number of flowers, pods, seeds per pod and test weight of seed leading to higher seed yield per hectare. These results are in conformation with Anitha *et al.* (2013) [1] in Soybean and Xalxo *et al.* (2007) [11] and Padamini *et al.* (2015) [9] in chickpea.

The wilt incidence per plot differed significantly due to seed priming during 2016, 2017 and pooled data. The results of pooled data revealed that, significantly lower wilt incidence (1.79%) (Table 4) was recorded due to seed priming with T_9 [Sprint (Mancozeb 50% + Carbendazim 25% WS) @ 2 g per kg of seed] as compared to other treatments and control (T_1) (13.26%). The probable reason may be due to role of combiproduct fungicide which act as preventive, curative systemic and contact fungicide which helps in colonizing the spindle production of fungi around seed (as compared to Desi type the seeds of Kabuli chickpea have very soft, delicate seed coat, with lower tannin content which are said to have important role in defence mechanism against various biotic and abiotic factors) from invading and survival of wide range of fungal pathogens around rhizospere during the crop period and provides a favorable condition by enhancing sufficient nutrient uptake from rhizosphere with better root system. Ravichandran and Hegde (2015) [13] opined that combi-product Carbendazim 12% + Mancozeb 63% (Saaf) were found to be effective at all concentrations (0.1, 0.2 and 0.3%) with highest inhibibition per cent against *Fusarium oxysporum f sp. ciceri* causing wilt of chickpea. Whereas, the treatment of seed hydro-priming + Vitavax Power @ 2g/kg seed gave complete control of *Macrophomina phaseolina, Aspergillus flavus, Aspergillus clavatus and Aspergillus niger* and also resulted in 99.0 per cent reduction in mycoflora infected seed. Hydro-priming was least effective and in fact increased the incidence of *Aspergillus clavatus*, *Aspergillus niger* and *Aspergillus versicolor*. Similarly, maximum seedling vigor index was observed in seed primed with *Pseudomonas fluorescens* and it was at par with seed priming + Vitavax Power seed treatment (Tak *et al.*, 2015) [14].

In addition, the presence of Zn and Mn in Sprint might have helped in inducing resistance in both, root and aerial plant parts disease of fungal origin, as Mn is taken up in higher amounts by the plants than by fungi, bacteria which exist in ample opportunity for the pathogen to exploit this difference in requirement leading to better formation of roots and early plant stand (Anon., 2018) [3] with effective field emergence percent leading to higher photosynthetic activity, formation of enhanced vegetative growth with higher number of branches and formation of higher number of flower, in further increased number of pod, with effective seed filling and maintenance of higher number of plant per plot and hectare leading to higher seed yield. These results are in conformation with Anitha *et al.* (2013) [1] in Soybean, Xalxo *et al.* (2007) [11] and Padamini *et al.* (2015) [9] in chickpea. However, the field emergence, crop growth, seed yield and disease incidence did not differ significantly due to interaction of seed priming treatments and varieties.

Table 1: Effect of seed priming on field emergence in Kabuli chickpea varieties

Varieties (V)	Field emergence (%)		
	2015-16	2016-17	Pooled
V_1: BG1105	82.33	80.84	81.59
V_2: MNK-1	81.82	78.83	80.33
S. Em. ±	0.03	0.20	0.12
C. D. @ 5%	0.19	1.24	0.71
Treatments (T)			
T_1: Control	88.07	85.42	86.74
T_2: Hydro priming	88.27	85.62	86.94
T_3: Calcium chloride @ 2%	91.33	88.69	90.01
T_4: $ZnSO_4$ @ 2 g per kg of seed	92.72	90.07	91.39
T_5: Cowurine @ 25%	89.18	86.54	87.86
T_6: Panchagavya @ 3%	90.68	88.04	89.36
T_7: Custard apple leaf extract @ 3%	91.10	88.46	89.78
T_8: Rhizobium (GR-2) @ 4 ml per kg of seed	90.60	87.96	89.28
T_9: Sprint (Mancozeb 50% + Carbendazim 25% WS) @ 2 g per kg of seed	98.83	97.58	98.21
S. Em. ±	0.38	0.46	0.39
C. D. @ 5%	1.10	1.33	1.12
Interaction (V×T)			

V_1T_1	88.57	86.79	87.68
V_1T_2	88.63	86.85	87.74
V_1T_3	91.30	89.52	90.41
V_1T_4	92.43	90.65	91.54
V_1T_5	90.00	88.22	89.11
V_1T_6	91.50	89.72	90.61
V_1T_7	91.07	89.29	90.18
V_1T_8	90.50	88.72	89.61
V_1T_9	99.33	98.67	99.00
V_2T_1	87.57	84.06	85.81
V_2T_2	87.90	84.39	86.15
V_2T_3	91.37	87.86	89.61
V_2T_4	93.00	89.49	91.25
V_2T_5	88.37	84.86	86.61
V_2T_6	89.87	86.36	88.11
V_2T_7	91.13	87.62	89.38
V_2T_8	90.70	87.19	88.95
V_2T_9	98.33	96.49	97.41
Mean	0.20	0.62	0.38
S.Em. ±	88.57	86.79	87.68
C.D. @ 5%	NS	NS	NS

NS: Non significant

Table 2: Effect of seed priming on plant height at different days after sowing (DAS) in Kabuli chickpea varieties

Varieties (V)	**Plant height (cm)**								
	At 30 DAS			**At 60 DAS**			**At harvest**		
	2015-16	**2016-17**	**Pooled**	**2015-16**	**2016-17**	**Pooled**	**2015-16**	**2016-17**	**Pooled**
V_1: BG1105	21.29	23.47	22.38	40.59	35.98	38.29	44.58	41.80	43.19
V_2: MNK-1	20.38	19.99	20.19	32.61	34.21	33.41	37.02	37.40	37.21
S. Em. ±	0.11	0.48	0.26	0.54	0.26	0.40	0.41	0.54	0.46
C. D. @ 5%	0.68	2.94	1.58	3.28	1.56	2.41	2.49	3.28	2.78
Treatments (T)									
T_1: Control	21.58	20.22	20.90	38.53	35.63	37.08	43.51	41.18	42.34
T_2: Hydro priming	21.94	20.44	21.19	39.73	36.28	38.01	44.10	41.39	42.74
T_3: Calcium chloride @ 2%	25.71	25.12	25.42	41.07	40.22	40.64	45.77	44.90	45.33
T_4: $ZnSO_4$ @ 2 g per kg of seed	26.06	26.84	26.30	42.03	41.80	41.92	46.18	46.05	46.11
T_5: Cowurine @ 25%	22.73	21.24	21.99	39.90	37.72	38.81	45.04	42.77	43.91
T_6: Panchagavya @ 3%	24.90	23.29	24.10	40.73	39.13	39.93	45.50	44.19	44.84
T_7: Custard apple leaf extract @ 3%	23.99	22.08	23.03	40.60	38.78	39.69	45.42	43.69	44.56
T_8: Rhizobium (GR-2) @ 4 ml per kg of seed	23.28	21.50	22.39	40.20	38.00	39.10	45.08	43.19	44.14
T_9: Sprint (Mancozeb 50% + Carbendazim 25% WS) @ 2 g per kg of seed	27.13	27.89	27.51	43.20	43.37	43.28	47.39	48.62	48.01
S. Em. ±	0.76	0.45	0.42	0.89	1.15	0.82	0.73	0.97	0.68
C. D. @ 5%	2.20	1.29	1.22	2.56	3.31	2.37	2.09	2.81	1.95
Interaction (V × T)									
V_1T_1	23.04	20.91	21.98	43.03	36.43	39.73	47.91	43.64	45.78
V_1T_2	23.36	21.01	22.18	43.77	37.33	40.55	48.49	43.98	46.23
V_1T_3	27.78	25.83	26.81	45.70	41.30	43.50	49.76	47.39	48.57
V_1T_4	28.40	26.91	27.66	46.43	42.33	44.38	50.44	47.91	49.18
V_1T_5	24.64	21.60	23.12	43.77	39.20	41.48	48.98	45.67	47.32
V_1T_6	26.69	23.59	25.14	45.17	40.07	42.62	49.27	46.57	47.92
V_1T_7	25.91	22.56	24.23	45.03	39.47	42.25	49.18	46.52	47.85
V_1T_8	24.76	21.82	23.29	44.63	39.27	41.95	49.02	46.06	47.54
V_1T_9	30.16	28.63	29.39	48.37	44.40	46.38	52.76	50.27	51.51
V_2T_1	20.11	19.53	19.82	34.03	34.83	34.43	39.11	38.71	38.91
V_2T_2	20.53	19.88	20.21	35.70	35.23	35.47	39.71	38.80	39.26
V_2T_3	23.64	24.41	24.03	36.43	39.13	37.78	41.78	42.41	42.09
V_2T_4	23.71	26.18	24.94	37.63	41.27	39.45	41.91	44.19	43.05
V_2T_5	20.82	20.88	20.85	36.03	36.23	36.13	41.11	39.88	40.49
V_2T_6	23.11	23.00	23.06	36.30	38.20	37.25	41.73	41.81	41.77
V_2T_7	22.07	21.60	21.83	36.17	38.10	37.13	41.67	40.87	41.27
V_2T_8	21.80	21.18	21.49	35.77	36.73	36.25	41.13	40.33	40.73
V_2T_9	24.11	27.16	25.63	38.03	42.33	40.18	42.02	46.98	44.50
Mean	24.15	23.15	23.65	40.67	38.99	39.83	45.33	44.00	44.67
S. Em. ±	1.41	0.38	0.76	1.58	0.91	1.19	1.21	1.59	1.33
C. D. @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS: Non significant

Table 3: Effect of seed priming on chlorophyll content (SPAD value) at different days after sowing (DAS) in Kabuli chickpea varieties

Varieties (V)	Chlorophyll content (SPAD value)								
	At 30 DAS			At 60 DAS			75 DAS		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
V_1: BG1105	42.17	43.75	42.96	47.16	49.05	48.11	44.58	47.31	45.94
V_2: MNK-1	38.15	38.58	38.36	42.40	42.57	42.49	40.28	39.82	40.05
S. Em. ±	0.65	0.85	0.19	0.67	0.72	0.68	0.63	1.05	0.66
C. D. @ 5%	3.95	5.19	1.15	4.06	4.39	4.12	3.82	6.42	4.00
Treatments (T)									
T_1: Control	41.98	42.26	42.12	46.99	48.14	47.57	43.31	44.84	44.07
T_2: Hydro priming	42.58	42.59	42.58	47.75	48.90	48.33	45.73	45.16	45.45
T_3: Calcium chloride @ 2%	44.88	47.63	46.26	50.06	51.20	50.63	46.04	50.37	48.20
T_4: $ZnSO_4$ @ 2 g per kg of seed	47.71	47.97	47.84	52.72	53.86	53.29	50.37	50.71	50.54
T_5: Cowurine @ 25%	42.88	43.51	43.20	48.06	49.20	48.63	45.87	46.25	46.06
T_6: Panchagavya @ 3%	44.61	46.51	45.56	49.62	50.76	50.19	47.43	49.25	48.34
T_7: Custard apple leaf extract @ 3%	43.58	45.66	44.62	49.25	50.40	49.82	46.57	47.73	47.15
T_8: Rhizobium (GR-2) @ 4 ml per kg of seed	43.01	44.68	43.84	48.18	49.33	48.76	46.00	47.42	46.71
T_9: Sprint (Mancozeb 50% + Carbendazim 25% WS) @ 2 g per kg of seed	50.34	50.83	50.59	55.18	56.33	55.76	53.00	53.91	53.45
S. Em. ±	1.27	1.06	0.80	0.97	0.99	0.97	1.18	1.19	0.84
C. D. @ 5%	3.64	3.04	2.31	2.81	2.81	2.81	3.41	3.43	2.41
Interaction (V × T)									
V_1T_1	43.97	44.00	43.99	49.30	51.40	50.35	44.17	48.03	46.10
V_1T_2	44.33	44.07	44.20	49.99	52.09	51.04	47.86	48.10	47.98
V_1T_3	47.54	51.09	49.31	53.20	55.30	54.25	47.40	55.12	51.26
V_1T_4	50.46	51.61	51.04	56.12	58.22	57.17	53.99	55.64	54.82
V_1T_5	44.62	45.90	45.26	50.28	52.38	51.33	48.15	49.93	49.04
V_1T_6	47.36	50.79	49.08	53.02	55.12	54.07	50.89	54.82	52.86
V_1T_7	45.42	49.79	47.61	51.08	53.18	52.13	48.95	53.16	51.06
V_1T_8	44.72	47.94	46.33	50.38	52.48	51.43	48.25	51.97	50.11
V_1T_9	53.24	52.29	52.77	58.23	60.33	59.28	56.10	56.32	56.21
V_2T_1	39.99	40.53	40.26	44.69	44.87	44.78	42.44	41.65	42.05
V_2T_2	40.83	41.11	40.97	45.52	45.71	45.61	43.61	42.22	42.92
V_2T_3	42.23	44.16	43.20	46.92	47.11	47.02	44.68	45.61	45.15
V_2T_4	44.96	44.34	44.65	49.32	49.50	49.41	46.74	45.79	46.26
V_2T_5	41.14	41.13	41.13	45.83	46.02	45.92	43.59	42.58	43.08
V_2T_6	41.86	42.22	42.04	46.22	46.40	46.31	43.97	43.67	43.82
V_2T_7	41.73	41.52	41.63	47.42	47.61	47.51	44.18	42.31	43.24
V_2T_8	41.29	41.42	41.36	45.98	46.17	46.08	43.74	42.87	43.31
V_2T_9	47.44	49.37	48.41	52.13	52.32	52.23	49.89	51.49	50.69
Mean	44.62	45.74	45.18	49.76	50.90	50.33	47.15	48.40	47.77
S. Em. ±	1.93	2.47	0.66	1.94	2.09	1.97	1.86	3.03	1.90
C. D. @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS: Non significant

Table 4: Effect of seed priming on seed yield and wilt incidence in Kabuli chickpea varieties

Varieties (V)	Seed yield (q/ha)			Wilt incidence (%)		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
V_1: BG1105	12.54	13.45	13.00	9.16	7.67	8.41
V_2: MNK-1	11.26	12.19	11.72	11.17	8.18	9.67
S. Em. ±	0.19	0.22	0.20	0.20	0.03	0.12
C. D. @ 5%	1.14	1.35	1.24	1.24	0.19	0.71
Treatments (T)						
T_1: Control	11.55	12.63	12.09	14.58	11.93	13.26
T_2: Hydro priming	12.43	13.52	12.98	14.38	11.73	13.06
T_3: Calcium chloride @ 2%	13.49	14.58	14.03	11.31	8.67	9.99
T_4: $ZnSO_4$ @ 2 g per kg of seed	13.80	14.88	14.34	9.93	7.28	8.61
T_5: Cowurine @ 25%	12.57	13.65	13.11	13.46	10.82	12.14
T_6: Panchagavya @ 3%	13.35	14.43	13.89	11.96	9.32	10.64
T_7: Custard apple leaf extract @ 3%	12.83	13.78	13.31	11.55	8.90	10.22
T_8: Rhizobium (GR-2) @ 4 ml per kg of seed	12.74	13.82	13.28	12.05	9.40	10.72
T_9: Sprint (Mancozeb 50% + Carbendazim 25% WS) @ 2 g per kg of seed	16.27	16.90	16.59	2.42	1.17	1.79
S. Em. ±	0.44	0.48	0.40	0.46	0.38	0.39
C. D. @ 5%	1.26	1.38	1.15	1.33	1.10	1.12
Interaction (V × T)						
V_1T_1	12.14	13.15	12.65	13.21	11.43	12.32
V_1T_2	13.49	14.50	13.99	13.15	11.37	12.26
V_1T_3	14.02	15.03	14.52	10.48	8.70	9.59

V_1T_4	14.37	15.37	14.87	9.35	7.57	8.46
V_1T_5	13.54	14.55	14.05	11.78	10.00	10.89
V_1T_6	13.89	14.89	14.39	10.28	8.50	9.39
V_1T_7	13.76	14.76	14.26	10.71	8.93	9.82
V_1T_8	13.57	14.58	14.07	11.28	9.50	10.39
V_1T_9	16.67	17.67	17.17	1.33	0.67	1.00
V_2T_1	10.95	12.12	11.53	15.94	12.43	14.19
V_2T_2	11.38	12.54	11.96	15.61	12.10	13.86
V_2T_3	12.96	14.13	13.54	12.14	8.63	10.39
V_2T_4	13.23	14.39	13.81	10.51	7.00	8.76
V_2T_5	11.59	12.75	12.17	15.14	11.63	13.39
V_2T_6	12.80	13.97	13.39	13.64	10.13	11.89
V_2T_7	11.90	12.80	12.35	12.38	8.87	10.62
V_2T_8	11.90	13.07	12.49	12.81	9.30	11.06
V_2T_9	15.87	16.14	16.01	3.51	1.67	2.59
Mean	13.22	14.24	13.73	11.29	8.80	10.05
S. Em. ±	0.57	0.66	0.61	0.62	0.20	0.38
C. D. @ 5%	NS	NS	NS	NS	NS	NS

NS: Non significant

Conclusion

The seed production of chickpea is taken during rabi/winter followed by kharif crops like groundnut, soybean pulses which are the host for many of seed and soil borne pathogens. The residual inoculums of kharif crops in soil which affect the chickpea crop by lower field performance and seed yield. In order to improve field emergence, seed yield and disease control, seed priming can be done with fungicides namely the Sprint [(Mancozeb 50% + Carbendazim 25% WS) @ 2 g per kg of seed] for obtaining higher field emergence, leading increased seed yield and lower disease incidence in kabuli chickpea varieties.

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