Mysore J. Agric. Sci., 57 (2) : 340-346 (2023)

Influence of Seed Treatment and Antioxidant Spray on Crop Growth, Seed Yield and Quality in White Cowpea [*Vigna unguiculata* (L.) Walp] cv. IT - 38956 - 1

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Shivakumar B. Bagli : Data analysis and drafted the manuscript;
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Received : March 2023
Accepted : June 2023

Abstract

An experiment was conducted at Department of Seed Science and Technology, UAS, GKVK, Bengaluru during *kharif*-2017 to study the influence of seed treatment and antioxidant spray on crop growth and seed yield in white cowpea. The seed treatment with micronutrient like $FeSO_4$ 1 per cent, $CaCl_2$ 1 per cent, Sulphur 1 per cent and antioxidant spray *viz.,* salicylic acid, ascorbic acid, @ 100 ppm and @ 150 ppm with their combinations with a control includes 15 treatments replicated three times under RCBD. The results revealed that seed treatment with ($FeSO_4$ 1 % + $CaCl_2$ 1 % + Sulphur 1 %) and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm) has registered higher crop growth and seed yield *viz.,* plant height at 30 DAS (15.41 cm), 60 DAS (27.76 cm) and at harvest (35.06 cm), number of leaves plant^{-1} at 60 DAS (19.20), number of branches plant^{-1} at 60 DAS (11.07) and at harvest (12.15), numbers of effective nodules at 60 DAS (16.68), seed size (5.86 cm^3), number of pods plant^{-1} (10.47), no of pods cluster^{-1} (3.27), pod length (14.86 cm), number of seeds pod^{-1} (10.00), seed yield plot^{-1} (0.83 kg), seed germination (92.50 %), test weight (151.90 g), mean seedling length (38.42 cm), mean seedling dry weight (52.83 mg), SVI-I (3553), SVI-II (4252), TDH (4.00 A_{480} nm) and lower electrical conductivity (515.70 µS cm^{-1}) compared to control and other treatments.

Keywords : Cowpea, Seed treatment, Antioxidant spray

The cowpea has been grown in India, since ancient times. It was noticed in old ethics and vedic times. It is one of species of the widely cultivated genus Vigna and belongs to family Leguminosae and native of Central Africa which is drought tolerant and warm weather crop. The cowpeas are well adopted to the drier regions of the tropics and known by many vernacular names like Lobia (Hindi), Alasande (Kannada) and Karamani (Tamil and Telugu) (Javeeda, 2001).

Cowpea is an important crop of the world covering an area of about 143.5 lakh ha with a production of 72.6 lakh tonnes and productivity of 585.6 kg ha^{-1}. In India, cowpea is grown in an area of 13 lakh ha with a production of 31 lakh tonnes and an average productivity of 238 kg ha^{-1}. The major cowpea growing states are Gujarat, Uttar Pradesh, Rajasthan, Tamil Nadu, Andhra Pradesh and Karnataka. In Karnataka, cowpea is grown in an area of 0.99 lakh ha with a production of 0.46 lakh tonnes and productivity of 426 kg ha^{-1} (Anonymous, 2015).

Pro-anthocyanidins and tannins are the major compounds involved in seed coat pigmentation. Cowpea has a relatively low cost and high quality source of protein. The crop growth, seed yield and quality is generally reduced due to presence of anti-nutrients such as phytates, fibres, trypsin inhibitors, lectins, tannins and polyphenols. These compounds reduces digestibility and quality of protein (Gatehouse and Boulter, 1989). Phytic acid blocks absorption of micronutrients such as P, Ca, Mg, Fe and Zn and negatively affects the absorption of lipids, proteins and also inhibits important digestive enzymes such as amylase, pepsin and trypsin.

Seed treatment with micronutrient promote the strong, steady growth of crops that produce higher seed yields and increase harvest quality maximizing a plant's genetic potential (Prajapati *et al.,* 2017) and also antioxidant has shown many important function in plant and can change physiological behaviour of plant (Kiran and Channakeshava, 2017). Foliar application with relative low concentration of antioxidant also promoted and influenced the growth, development, differentiation of plants and enhanced the plant growth, seed yield parameters (Siamak *et al.,* 2014) and quality parameters (Hashmi *et al.,* 2012).

Material and Methods

An experiment was conducted to study the influence of seed treatment and antioxidant spray on crop growth, seed yield and quality in white cowpea [*Vigna unguiculata* (L.) Walp] cv. IT-38956-1 during Kharif, 2017 at E6-Block, GKVK campus, University of Agricultural Sciences, Bangalore which is situated between 13° 15' N latitude and 77° 32' East longitudes, at 930 m altitude above Mean Sea Level (MSL), which represents the Agro-climate of Eastern Dry Zone of Karnataka. The soil of the experimental sites was red sandy loam in texture. The moisture content at field capacity was 18.63 per cent with a bulk density of 1.43 g cc^{-1}. The soil of the site was slightly acidic in reaction (pH 5.8 to 6.1) and electrical conductivity was medium (0.32 to 0.36 dS m^{-1}). The organic carbon content was low (0.42 to 0.48%). The available nitrogen was low (228.2 kg ha^{-1}). Phosphorus was high (62.5 kg ha^{-1}) and potassium was also high (256.1 kg ha^{-1}). Cowpea variety cv. IT-38956-1 was used in the experimentation. There were fifteen treatment combination of seed treatment with micronutrient ($FeSO_4$ 1%, $CaCl_2$ 1% and Sulphur 1%) and antioxidant spray (Salicylic acid + Ascorbic acid) @ 100 ppm and @ 150 ppm replicated thrice in randomised complete block design. Treatments are T_0 - Control (no seed treatment and no foliar spray of antioxidants), T_1 - Seed treatment with $FeSO_4$ 1% and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm), T_2 - Seed treatment with $FeSO_4$ 1 per cent and foliar spray of (salicylic acid @ 150 ppm + ascorbic acid @ 150 ppm), T_3 - Seed treatment with $CaCl_2$ 1 per cent and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm), T_4 - Seed treatment with $CaCl_2$ 1 per cent and foliar spray of (salicylic acid @ 150 ppm + ascorbic acid @ 150 ppm), T_5 - Seed treatment with Sulphur 1 per cent and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm), T_6 - Seed treatment with Sulphur 1 per cent and foliar spray of (salicylic acid @ 150 ppm + ascorbic acid @ 150 ppm), T_7 - Seed treatment with ($FeSO_4$ 1 per cent + $CaCl_2$ 1 per cent) and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm), T_8 - Seed treatment with ($FeSO_4$ 1% + $CaCl_2$ 1%) and foliar spray of (salicylic acid @ 150 ppm + ascorbic acid @ 150 ppm), T_9 - Seed treatment with ($CaCl_2$ 1% + Sulphur 1%) and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm), T_{10} - Seed treatment with ($CaCl_2$ 1% + Sulphur 1%) and foliar spray of (salicylic acid @ 150 ppm + ascorbic acid @ 150 ppm), T_{11} - Seed treatment with ($FeSO_4$ 1% + Sulphur 1%) and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm), T_{12} - Seed treatment with ($FeSO_4$ 1% + Sulphur 1%) and foliar spray of (salicylic acid @ 150 ppm + ascorbic acid @ 150 ppm), T_{13} - Seed treatment with ($FeSO_4$ 1% + $CaCl_2$ 1% + Sulphur 1%) and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm), T_{14} - Seed treatment with ($FeSO_4$ 1% + $CaCl_2$ 1% + Sulphur 1%) and foliar spray of (salicylic acid @ 150 ppm + ascorbic acid @ 150 ppm). Sowing and cultural practices were carried out as per the package of practice except seed treatment and antioxidants was sprayed at 40 DAS. Crop growth, seed yield and quality observations were recorded in field.

Results and Discussion

Crop Growth

Crop growth parameters differed significantly among the treatments (Table 1). The seed treatment with

TABLE 1

Influence of seed treatment and antioxidant spray on crop growth attributes in white cowpea cv. IT-38956-1

Treatments	Plant height (cm)			Number of leaves plant^{-1}	Number of branches plant^{-1}		Number of effective nodules
	30 DAS	60 DAS	At harvest	60 DAS	60 DAS	At harvest	60 DAS
T_0	10.21	21.21	27.00	11.60	8.60	9.00	9.00
T_1	14.25	21.98	30.49	12.60	8.80	10.07	15.10
T_2	13.52	24.26	29.85	13.67	9.33	9.73	10.00
T_3	12.63	21.83	29.50	13.20	9.33	9.60	13.00
T_4	14.30	24.01	30.00	15.00	9.47	10.13	13.33
T_5	12.56	21.33	30.65	12.87	9.73	9.75	11.00
T_6	13.95	22.57	28.79	15.00	9.37	10.53	9.00
T_7	15.18	26.23	31.29	13.07	9.47	10.00	15.33
T_8	15.03	25.99	31.18	13.73	8.67	9.88	12.30
T_9	14.73	24.97	31.81	12.40	9.33	10.84	9.60
T_{10}	14.65	24.65	31.52	14.47	10.40	10.43	9.00
T_{11}	15.28	27.23	34.97	15.40	10.33	11.29	15.60
T_{12}	15.16	26.51	33.90	14.60	8.93	10.25	11.33
T_{13}	15.41	27.76	35.06	19.20	11.07	12.15	16.68
T_{14}	14.41	25.55	30.01	13.93	9.53	10.50	15.33
S.Em±	0.75	1.51	1.47	0.90	0.40	0.48	0.85
CD (P= 0.05)	2.17	4.38	4.27	2.62	1.17	1.39	2.59
CV (%)	9.24	10.75	8.21	11.14	7.41	8.09	9.78

($FeSO_4$ 1% + $CaCl_2$ 1% + Sulphur 1%) and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm) (T_{13}) recorded significant higher plant height of (15.41 cm @ 30 DAS, 27.76 cm @ 60 DAS and 35.06 cm at harvest), number of leaves plant^{-1} (19.20 @ 60 DAS), number of branches plant^{-1} (11.07 @ 30 DAS and 12.15 at harvest) and number of effective nodules (16.68 @ 60 DAS) as compared to control (T_0) (10.21 cm, 21.21 cm, 27.00 cm, 11.60, 8.60, 9.00 and 9.00 respectively) Fig. 1.

It is evident from the results that seed treatment with micronutrient which modifies the physiological and biochemical nature of seeds and antioxidant spray with salicylic acid and ascorbic acid enhance the accumulation of chlorophyll, betacyanin, total phenols and antioxidant activity which would likely to increase as indicated by Manjunath *et al.* (2011) in chickpea

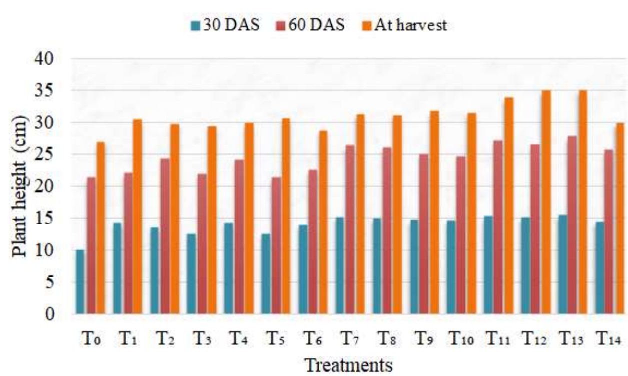

Fig. 1 : Influence of seed treatment and antioxidant spray on plant height at 30 DAS, 60 DAS and at harvest in white seeded cowpea cv. IT-38956-1

and Khandakar *et al.* (2011) in red amaranth. The results are in same line with studies made by Prajapati *et al.* (2017) in blackgram and Rehman *et al.* (2011) in rice. More number of leaves per plant might be

TABLE 2

Effect of seed treatment and antioxidant spray on seed yield attributes in white cowpea cv. IT 38956-1

Treatments	Seed size (cm^3)	No. of pods plant-[1]	No. of pods cluster^{-1}	Pod length (cm)	No of seeds pod^{-1}	Seed yield plot^{-1} (kg)
T_0	5.00	5.05	2.20	8.46	4.20	0.61
T_1	5.43	5.60	2.40	10.42	8.20	0.72
T_2	5.13	5.60	2.33	10.20	8.20	0.66
T_3	5.31	5.30	2.40	9.86	6.60	0.63
T_4	5.46	5.40	2.33	10.64	7.20	0.75
T_5	5.10	5.40	2.45	9.48	6.00	0.63
T_6	5.38	5.87	2.53	10.32	6.80	0.71
T_7	5.63	6.80	2.47	11.58	8.40	0.75
T_8	5.30	7.27	2.53	11.36	7.40	0.80
T_9	5.59	5.93	2.40	11.28	7.60	0.78
T_{10}	5.56	6.60	2.53	11.02	8.60	0.81
T_{11}	5.73	9.40	3.20	14.34	9.80	0.82
T_{12}	5.68	7.93	2.80	13.76	9.20	0.81
T_{13}	5.86	10.47	3.27	14.86	10.00	0.83
T_{14}	5.54	7.67	2.80	10.94	8.20	0.80
S.Em±	0.12	0.45	0.13	0.90	0.68	0.048
CD (P= 0.05)	0.374	1.31	0.40	2.749	2.08	0.145
CV (%)	3.22	11.73	9.35	11.409	12.50	10.54

due to cell division and cell elongation by antioxidants. Similar finding were reported by Mohsen (2014) in tomato plants, Seadh and Metwally (2015) in wheat. More number of branches plant^{-1} might be due to cell division and cell elongation by seed treatment with micronutrient and antioxidant spray. Similar findings were reported by Seadh and Metwally (2015) in wheat. More number of effective nodules might be due to seed treatment with micronutrient which enhances the symbiotic relationship between rhizobia and plant. Thus the development of nodules, while depend on rhizobia, is a well-coordinated development process of the plant which is reported by Mylona *et al.* (1995).

Seed Yield

Seed yield parameters differed significantly among the treatments (Table 2). The seed treatment with ($FeSO_4$ 1% + $CaCl_2$ 1% + Sulphur 1%) and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm) (T_{13}). Registered significantly higher seed size of (5.86 cm^3), number of pods plant^{-1} (10.47), number of pods cluster^{-1} (3.27), pod length (14.86 cm), number of seeds pod^{-1} (10.00) and seed yield plot^{-1} (0.83 kg) compared to control (T_0) which recorded the lowest seed yield attributes (5.00 cm^3, 5.05, 2.20, 8.46, 4.20 and 0.61 kg respectively) Fig. 2.

The increase in seed yield attributes like seed size is due to presence of higher amount of stored food material which reflected in higher seed size indicated by Manjunath *et al.* (2011) in chickpea, Prajapati *et al.* (2017) in blackgram and The results are in same line with studies made by Chavan and Tagad. (2013) in soybean and Abbas *et al.* (2009) in wheat. Increase in number of pods plant^{-1}, number of pods cluster^{-1},

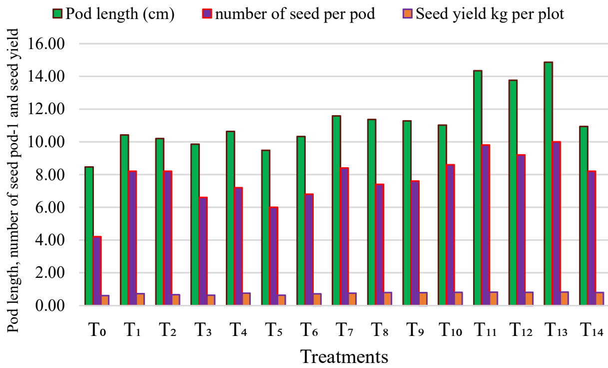

Fig. 2. Influence of seed treatment and antioxidant spray on pod length (cm), number of seeds pod^{-1} and seed yield plot^{-1} in white seeded cowpea cv. IT 38956-1

pod length and number of seeds pod^{-1} might be attributed to bio regulator effect of ascorbic acid and salicylic acid on physiological and biochemical process in plants such as ion uptake, cell elongation, cell division, cell differentiation, sink and source regulation, enzymatic activities, protein synthesis and photosynthetic activity, as well as, increase in antioxidant capacity of plant.

The results are in agreement with research findings of Amal *et al.* (2009) in pea, Abido *et al.* (2015) in sugar beet, Bhingarde *et al.* (2015) in groundnut and Gad el-hak *et al.* (2012) in peas. Increase in seed yield is mainly dependent on source sink relation. As the reproductive get more photosynthetic assimilate, an increase in seed yield is resulted. Improvement in seed yield components might be due to improved vegetative growth. The overall improvement in growth and yield components may be due to synergistic effect of combined use of antioxidants. Similar results were reported by Shabana *et al.* (2015) in sweet pepper, Amal *et al.* (2009) in pea, Bhaarati *et al.* (2010) in soyabean, Prajapati *et al.* (2017) in blackgram and Tabatabaei (2013) in sorghum and Nagraj *et al.,* 2017 in pigeonpea.

Seed Quality

Seed quality parameters differed significantly among the treatments (Table 3 and 4). The seed quality parameters were significantly higher in seed treatment with ($FeSO_4$ 1% + $CaCl_2$ 1% + Sulphur 1%) and foliar spray of (salicylic acid @ 100 ppm + ascorbic acid @ 100 ppm) (T_{13}). Seed germination of (92.50%), test weight (151.90 g), mean seedling length (38.42 cm), mean seedling dry weight (80.78 mg), SVI-I (3553), SVI-II (7472), total dehydrogenase activity (4 A_{480} nm) and lowest electrical conductivity (515.70 µScm^{-1}) compared to control (T_0) (80.50%, 127.45 g, 23.12 cm, 52.83 mg, 1861, 4252, 2.52 A_{480} nm and 876.00 µS cm^{-1} respectively) Fig. 3 & 4.

TABLE 3

Influence of seed treatment and antioxidant spray on seed quality attributes in white cowpea cv. IT-38956-1

Treatments	Germination (%)	Test weight (g)	Mean seedling length (cm)	SVI-I
T_0	80.50	127.45	23.12	1861
T_1	81.50	137.05	28.82	2348
T_2	81.50	132.45	32.51	2649
T_3	84.00	135.65	31.75	2667
T_4	83.00	138.15	28.38	2355
T_5	84.50	133.35	29.00	2450
T_6	83.00	130.05	27.00	2241
T_7	84.00	141.10	31.45	2766
T_8	84.00	140.45	32.16	2701
T_9	87.00	138.95	28.14	2448
T_{10}	88.50	142.80	34.79	3078
T_{11}	92.00	147.15	35.00	3220
T_{12}	89.50	132.15	34.28	3068
T_{13}	92.50	151.90	38.42	3553
T_{14}	90.00	139.30	33.37	3003
S.Em±	1.89	24.814	1.06	71.20
CD (P= 0.05)	5.70	74.796	3.20	214.64
CV (%)	3.12	2.545	4.81	3.74

Germination percentage differed significantly among treatments. Maximum germination was noticed in T_{13}. This might be due to enhanced source to sink relation. Seeds contain greater metabolites for resumption of embryonic growth during germination and better accumulation of food reserves like protein and carbohydrates as reported by Bhaarati, *et al.* (2013) in soybean, Chavan and Tagad (2015) in soybean and Tabatabaei (2013) in sorghum seed. Higher test weight was recorded in T_{13}. This might be due to presence of higher amount of stored food material in seed as indicated by Manjunath *et al.* (2011) in chickpea,

TABLE 4

Influence of seed treatment and antioxidant spray on seed quality attributes in white cowpea cv. IT-38956-1.

Treatments	Mean seedling dry weight (mg)	SVI-II	TDH (A_{480} nm)	EC (µS cm^{-1})
T_0	52.83	4252	2.52	876.00
T_1	56.48	4603	2.57	707.40
T_2	61.55	5016	2.80	744.30
T_3	64.40	5409	2.97	757.10
T_4	63.03	5231	2.71	713.15
T_5	56.50	4773	2.80	800.65
T_6	57.17	4744	2.68	754.80
T_7	60.27	5061	3.38	823.15
T_8	63.40	5324	3.48	661.00
T_9	71.62	6230	3.67	674.70
T_{10}	68.09	6025	3.10	729.30
T_{11}	74.63	6865	3.74	571.40
T_{12}	73.84	6608	3.59	634.20
T_{13}	80.78	7472	4.00	515.70
T_{14}	73.85	6615	3.21	710.05
S.Em±	1.37	86.78	0.06	20.61
CD (P= 0.05)	4.15	261.60	0.19	62.14
CV (%)	2.98	2.18	2.85	4.09

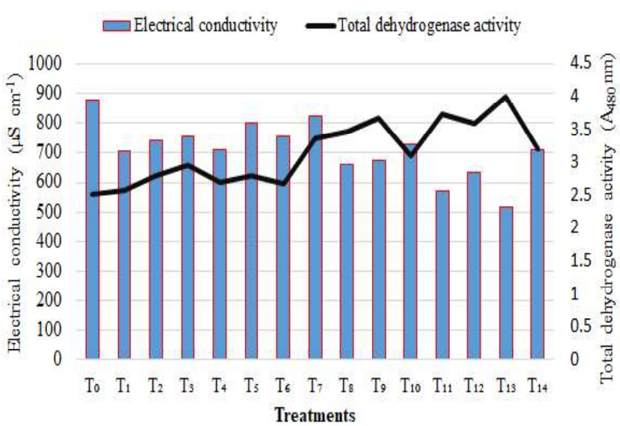

Fig. 3: Influence of seed treatment and antioxidant spray on electrical conductivity (µS cm^{-1}) and total dehydrogenase activity (A_{480} nm) in white seeded cowpea cv. IT 38956-1

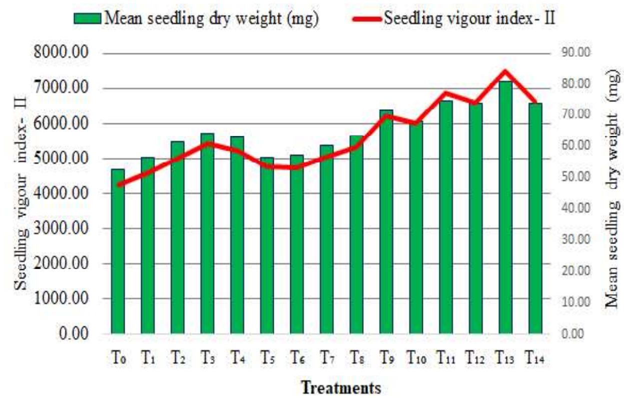

Fig. 4: Influence of seed treatment and antioxidant spray on seedling vigour index- II and mean seedling dry weight (mg) in white seeded cowpea cv. IT 38956-1

Prajapati *et al.* (2017) in blackgram and the results are in same line with studies made by Chavan and Tagad. (2015) in soybean and Abbas *et al.* (2009) in wheat. Increase in mean seedling length, mean seedling dry weight, seedling vigour index-I and seedling dry weight (mg) might be due to increase in root length and shoot length which in turn is attributed to presence of higher amount of stored food material as indicated by Bhaarati *et al.* (2013) in soybean and Chavan and Tagad (2015) in soybean. The results are in same line with studies made by Khandaker (2011) in red amaranth and Hashmi *et al.* (2012) in fennel. Highest TDH activity registered in T_{13} might be due to application of antioxidant as foliar spray which resulted in enhanced source to sink relation leads to better accumulation of food reserves like protein. Lowest electrical conductivity documented in T_{13}. This might be due to production of quality seeds with high cell wall integrity and low leakage of metabolites from seeds when soaked in water. Similar results were also obtained by Bhingarde *et al.* (2015) in groundnut and Bhaarati *et al.* (2013) in soybean.

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