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EFFECT OF SEED PRIMING AND FUNGICIDE TREATMENT ON CHICKPEA (*Cicer arietinum*) SOWN AT DIFFERENT SOWING DEPTHS IN *KANDI* BELT OF LOW ALTITUDE SUB-TROPICAL ZONE OF JAMMU

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ABSTRACT

Field experiments were conducted during *rabi* 2007-08, 2008-09 and 2009-10 at PRSS, Samba, SKUAST-Jammu in *Inceptisols* to find out the effects of seed priming, sowing depth and seed treatment with fungicide on chickpea. The treatments consisted of seed priming (seed soaking in water for 8 h), sowing depth (7.5 and 10 cm) and seed treatment with carbendazim 50WP. The observations on plant height, nodule dry weight, seed index, dry matter accumulation, yield and yield attributes of chickpea were recorded. The results revealed that the growth parameters of chickpea were significantly affected by seed priming, sowing depth and seed treatment with fungicide. Dry matter accumulation, yield and yield attributes differed significantly with seed priming and sowing depth. Plant height of chickpea showed significantly highly correlation with nodule dry weight accumulation which, in turn, enhanced the seed and biological yield with the accuracy of 87%.

Keywords: Dry matter accumulation, growth, fungicide, seed priming, sowing depth, yield

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the largest produced food legume in South Asia and the 3rd largest produced food legume globally after common bean and field pea. Chickpea is grown in more than 50 countries with 89.7% production area in Asia alone. India is the largest chickpea producing country accounting for 64% of the global chickpea production (Gaur *et al.*, 2010). It is an important pulse crop in India sharing 29.7 and 38% of the total area and production of total pulses, respectively (Chand *et al*., 2010). In Jammu & Kashmir state, chickpea is grown on 4300 ha area with annual production of 2550 metric tonnes and productivity of 593 kg ha^{-1} (Singh *et al*., 2010). Most of the area under pulses is rainfed and hence the basic reason for low productivity. Pulses are considered environment friendly because of their reduced dependence on fossil fuels. The crop is able to obtain most of its nitrogen requirement from atmosphere through symbiotic relationship with *Rhizobium* (Anonymous, 2002). Amongst pulses, chickpea has high protein digestibility and is richer in phosphorus and calcium. It possesses higher fat content and has better fibre digestibility. Chickpea straw has better forage value than the straws commonly used as livestock feed (Saxena and Singh, 1987). Seed priming is basically a pre-sowing seed soaking treatment meant to improve crop establishment (Harris, 1996). Harris *et al*. (1999) have reported seed priming as one of the important practices which ensures rapid and uniform germination under adverse environmental conditions. The sowing soaked seed decreases germination time and helps the seedling to escape deteriorating soil physical conditions. Sowing depth is another determinant affecting seedling emergence and crop establishment under dryland situations where temperature and soil evaporation rates are high (Siddique and Loss, 1996). Seed sowing at proper depth under low rainfall situations reduces the risk of poor crop establishment. Seed treatment with fungicides is a part of an overall strategy to reduce losses from seed and soil borne diseases in pulse crops. Treating the pulse seed with fungicide reduces the establishment of seed-borne diseases. Keeping in view these facts, the present investigation was undertaken to assess the performance of seed priming, sowing depth and seed treatment in chickpea under dryland conditions of Jammu & Kashmir.

MATERIALS AND METHODS

The field experiments on chickpea were conducted in *rabi* seasons of 2007-08, 2008-09 and 2009-10 at the Agronomy Research Farm of Pulses Research Sub-Station, Arazi, Samba, SKUAST-Jammu (32^0 $34^/$ N, 70^0 $83^/$ E, 330 m amsl). The treatments comprized of two levels of seed priming (water soaking for 8 h and no soaking) and two sowing depths (7.5 and 10.0 cm) with and without carbendazim 50WP treatment @ 2 g kg^{-1} seed. Each treatment was replicated thrice in split plot design. The soil texture of experimental site was sandy loam having 0.33% organic C and 21.7 and 269 kg ha^{-1} available P and K, respectively. Chickpea variety 'GNG-469' was sown @ 75 kg ha^{-1} at plant spacing of 30 x 10 cm on 12 October, 2007, 14 October, 2008 and 10 December, 2009 and harvested on 17 April, 2008, 3 April, 2009 and 16 April, 2010 in *rabi* 2007-08, 2008-09 and 2009-10, respectively. In thoroughly prepared seed beds, uniform dose of 20 kg N and 50 kg P_2O_5 ha^{-1} was applied to the crop at sowing time in the form of diammonium phosphate. For nodule weight, randomly selected 3 plants were gently uprooted from each plot, their roots washed, nodules separated and shade dried for 2-3 days. The nodules were oven-dried at 65±5°C for 3 days till constant weight. The rainfall received during the cropping seasons was 176.8, 163.4 and 44.3 mm with 8, 12 and 5 rainy days in 2007-08, 2008-09 and 2009-10, respectively. For dry matter estimation, 5 plants were randomly selected at various time intervals and at harvest from each treatment and oven-dried at 65±5^{O}C till constant weight. The statistical analysis was done by using OPSTAT software developed by CCSHAU, Hisar (Haryana).

RESULTS AND DISCUSSION

Effect of seed priming

Soaking chickpea seeds in water for about 8 h significantly influenced plant height and nodule dry weight (Table 1) in comparison to unsoaked seeds during all three years of study. However, non-significant results were observed with respect to seed index. Seed priming significantly affected dry

Table 1: Effect of seed priming, depth of sowing and fungicide application on growth parameters of chickpea

Treatments	Plant height (cm)				Nodule dry weight (mg $plant^{-1}$)				Seed index (g per 100 seed weight)			
	2007-08	2008-09	2009-10	Mean	2007-08	2008-09	2009-10	Mean	2007-08	2008-09	2009-10	Mean
<u>Seed priming</u>												
Water soaking	64.3	61.2	56.5	60.6	114.5	102.5	91.0	102.7	26.1	24.1	22.1	24.1
No soaking	57.1	53.6	49.5	53.4	98.8	86.5	73.8	86.3	24.9	23.4	21.3	23.2
$CD_{0.05}$	2.1	4.2	3.4	0.9	1.7	9.8	6.4	2.0	Ns	ns	ns	ns
<u>Seed sowing depth</u>												
7.5 cm	57.3	52.9	48.9	53.1	99.3	87.3	75.3	87.3	25.0	23.4	21.3	23.2
10.0 cm	64.0	61.9	56.9	60.9	114.0	101.8	89.5	101.8	26.0	24.1	22.1	24.1
$CD_{0.05}$	1.6	1.5	2.1	3.6	6.7	8.7	13.0	0.5	Ns	ns	ns	ns
<u>Fungicide treated</u>												
Untreated	59.4	55.9	51.4	55.5	102.8	91.0	78.5	90.8	25.3	23.5	21.5	23.4
Treated	61.9	59.0	54.6	58.5	110.5	98.0	86.3	98.3	25.8	23.9	21.9	23.9
$CD_{0.05}$	5.9	2.1	1.9	2.6	ns	ns	ns	ns	Ns	ns	ns	ns

ns: not significant

matter accumulation at various time intervals and at harvest. Seed priming, on an average, yielded 22.1% higher dry matter accumulation at different time intervals after sowing (Fig. 1). At harvest, seed priming registered statistically higher pods plant^{-1}, seeds pod^{-1}, grain and biological yield which were 27.0, 11.9, 23.1 and 22.0% higher over no seed priming (Table 2). Harris (2006) has reported improvement in seed yield in various crops at farmer's field by seed priming with water. The higher values obtained for growth parameters, periodic dry matter accumulation, yield and yield attributes with seed priming may be due to the fact that primed seeds usually exhibit an increased germination rate and greater germination uniformity (Basra *et al.*, 2005). The results are in conformity with Bray *et al.* (1989) and Lin and Sung (2001).

The interaction between seed priming and sowing depth significantly affected the growth and yield of chickpea (Table 2). The interaction effect between seed priming and fungicide treatment observed is in conformity with Cumming and Jenkins (2011) who registered improvement in chickpea. The interaction effect between seed priming, sowing depth and fungicide application were non-significant, except for nodule dry weight.

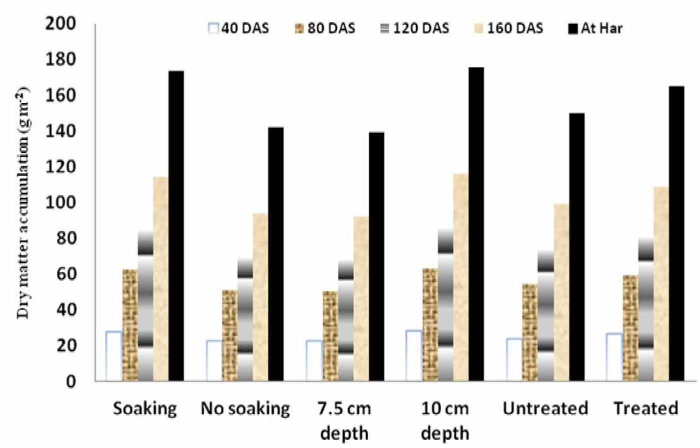

Fig. 1. Effect of different treatments on periodic dry matter accumulation in chickpea (mean of 3 years)

Effect of depth of sowing

The plant height, nodule dry weight and seed index in chickpea increased when seeds were sown at 10 cm depth in comparison to 7.5 cm sowing depth. However, significant variations were noticed in plant height and nodule weight in 2007-08, 2008-09 and 2009-10 but not for seed index (Table 1). The nodulation at deeper sowing depth. Deeper seed depth recorded significantly higher periodic dry matter accumulation at different intervals of time than 7.5 cm depth. At harvest, 25.7% higher dry matter production was observed in plants where seed was sown

Table 2: Effect of seed priming, depth of sowing and fungicide application on yield and attributes of chickpea

Treatments	Pods plant^{-1} (No.)				Seeds pod^{-1} (No.)				Grain yield (kg ha^{-1})				Biological yield (kg ha^{-1})			
	2007-08	2008-09	2009-10	Mean	2007-08	2008-09	2009-10	Mean	2007-08	2008-09	2009-10	Mean	2007-08	2008-09	2009-10	Mean
Seed priming																
Water soaking	32.2	25.1	23.1	26.8	1.69	1.35	1.20	1.41	781.2	597.8	531.9	636.9	1997	1773	1428	1733
No soaking	27.2	19.3	16.8	21.1	1.47	1.21	1.10	1.26	602.2	506.4	443.9	517.5	1580	1517	1165	1420
$CD_{0.05}$	1.9	2.1	5.6	1.5	0.08	0.09	0.06	0.15	49.3	62.1	6.4	56.2	218	115	16.9	229
Seed sowing depth																
7.5 cm	26.3	19.4	17.1	20.9	1.46	1.20	1.10	1.26	597.0	501.1	439.9	512.7	1511	1525	1154	1396
10.0 cm	33.1	25.0	22.8	26.9	1.70	1.36	1.20	1.42	786.4	603.2	535.8	641.8	2066	1765	1439	1756
$CD_{0.05}$	2.2	2.9	5.6	1.4	0.20	1.10	0.09	0.08	39.9	71.0	14.5	70.2	113	93	41.7	213
Fungicide treated																
Untreated	27.8	20.4	18.2	22.1	1.52	1.23	1.12	1.29	643.9	525.9	463.1	544.3	1692	1572	1223	1496
Treated	31.7	23.9	21.7	25.8	1.64	1.33	1.18	1.38	739.5	578.3	512.7	610.1	1885	1717	1370	1657
$CD_{0.05}$	2.7	3.2	3.4	3.1	ns	ns	ns	ns	60.3	58.2	9.0	42.3	248	85	24.3	172

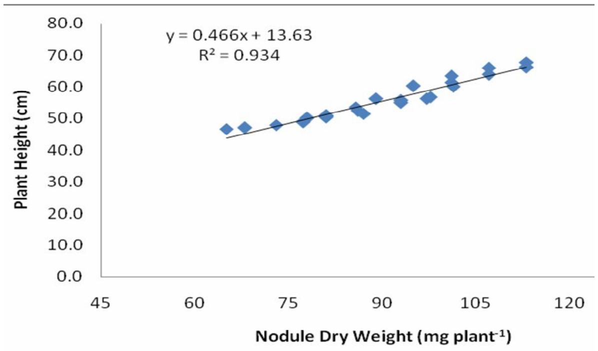

Fig. 2. Relationship between nodule dry weight and plant height of chickpea

at 10 cm than those sown at 7.5 cm depth (Fig. 1). The benefits accrued due to deep sowing may be attributed to the optimum use of moisture stored in soil from *monsoon* rainfall. Seeding depth of 10 cm gave significantly higher pods plant^{-1}, seeds pod^{-1} and grain and biological yield than 7.5 cm seeding depth. The grain and biological yields obtained in 10 cm seed depth treatment were 25.2 and 28.8% higher than the yields in 7.5 cm seed depth (Table 2). Higher productivity with deeper sowing seems due to better tolerance of chickpea at deeper sowing through better crop establishment and seed germination (Siddique and Loss 1996). Malhotra *et al.* (1990) also registered better seed germination and crop establishment in chickpea at 10 cm sowing depth. Interaction between sowing depth and fungicidal treatment was significant for growth parameters, periodical dry matter accumulation and seed and biological yield, except for plant height, pods plant^{-1} and seeds pod^{-1} (Table 3).

Table 3: Interaction effect of different treatments on growth, yield and other parameters of chickpea (mean of three years)

Treatments	Plant height (cm)	Nodule dry wt. (mg plant^{-1})	Seed index (g)	Pods plant^{-1}	Seeds pod^{-1}	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Periodic dry matter (g m^{-2}) 40 DAS	80 DAS	120 DAS	160 DAS	At Harvest
Seed soaking (SS) + sowing depth (7.5 cm) with fungicide treatment (FT)	56.8	98	23.8	25.0	1.35	566.0	1528.9	24.5	54.0	73.4	98.8	149.8
SS + SD (7.5 cm) without FT	55.8	93	23.5	22.7	1.28	534.5	1451.7	23.3	53.9	72.9	98.3	148.2
SS + SD (10 cm) without FT	63.9	107	24.3	27.8	1.47	674.5	1871.8	30.0	67.4	91.8	123.6	187.2
SS + SD (10.0 cm) + FT	66.1	113	24.7	31.8	1.54	772.7	2078.0	33.3	74.7	101.7	137.1	207.8
No SS + SD (7.5 cm) without FT	48.9	77	22.6	16.1	1.14	467.2	1280.4	20.6	46.2	62.8	84.5	128.0
No SS + SD (7.5 cm) + FT	50.9	81	22.9	20.0	1.22	482.8	1324.9	21.2	48.0	65.0	87.5	132.5
No SS + SD (10 cm) without FT	53.6	86	23.2	21.9	1.26	501.0	1379.1	22.1	49.7	67.6	91.1	137.9
NoSS + SD (10.0 cm) + FT	60.2	101	24.0	26.3	1.40	619.0	1697.4	27.3	61.3	83.2	112.1	169.7
SS x SD	5.1	0.7	0.2	2.1	0.11	99.3	301.8	4.8	11.1	14.9	19.9	30.2
SS x FT	ns	0.8	ns	ns	ns	ns	ns	ns	ns	Ns	ns	ns
SD x FT	ns	0.8	0.2	ns	ns	32.8	78.5	1.3	3.2	4.5	5.9	8.9
SS x SD x FT	ns	1.2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

DAS - days after sowing; *Fungicide; **Seed treatment is with fungicide (Carbendazim 50WP @ 2 g kg^{-1} seed);

Effect of fungicidal application

Pre-sowing treatment of chickpea seeds with carbendazim 50WP gave significantly taller plant than untreated ones during all the three seasons. However, nodule weight and seed index did not show any significant improvement (Table 1). Seed treatment with fungicide resulted in significantly higher dry matter production (Fig. 1) at various time intervals than untreated ones with 11.3, 9.6, 9.4, 9.0 and 9.7% increase in periodic dry matter production at 40, 80, 120, 160 DAS and at harvest, respectively (mean values). Pods plant^{-1} and seed and biological yield showed significant variation due to fungicide treatment (Table 2). The grain and biological yields obtained with fungicidal seed treatment were 12.1 and 10.8% higher over no seed treatment. Interaction between fungicide use and sowing depth was significant for

Table 4: Correlation of weather parameters with plant growth parameters, seed yield and yield attributes of chickpea sown under rainfed condition of Jammu

Parameters	Rainfall (mm)	Temperature (°C)		Relative humidity (%)		Evapora-tion (mm)	Sun shine (h)
		Maximum	Minimum	Morning	Evening		
Plant height (cm)	0.178	0.677**	0.917**	0.893**	0.254	0.296	0.277
Nodule dry weight (mg plant^{-1})	0.443*	0.623**	0.938**	0.924**	0.307	-0.228	0.422*
Seed index (g)	0.857**	0.894**	0.850**	0.481*	0.458*	-0.344	0.489*
Pods (No. plant^{-1})	0.304	0.696**	-0.878**	-0.993**	0.267	-0.301	0.370
Seed (No. pod^{-1})	0.496*	0.973**	-0.652**	0.448*	0.430*	-0.329	0.308
Grain Yield (kg ha^{-1})	0.517*	-0.843**	-0.457*	0.475*	0.397	-0.312	0.252
Biological yield (kg ha^{-1})	0.635**	-0.814**	-0.601**	0.302	0.425*	-0.313	0.261
Dry matter at 40 DAS (g m^{-2})	0.648**	0.815**	0.620**	0.296	0.426*	-0.309	0.659**
Dry matter at 80 DAS (g m^{-2})	0.656**	0.860**	0.656**	0.333	0.412*	-0.299	0.779**
Dry matter at 120 DAS (g m^{-2})	0.640**	0.853**	0.644**	0.330	0.410*	-0.302	0.573*
Dry matter at 160 DAS (g m^{-2})	0.639**	0.856**	0.647**	0.332	0.409*	-.0300	0.674**
Dry matter at harvest (g m^{-2})	0.634**	0.846**	0.632**	0.327	0.412*	-0.305	0.571*

*Correlation is significant at the 0.05 level (2-tailed); DAS = days after sowing

all growth parameters, periodic dry matter production and grain and biological yield; except for plant height, pods plant^{-1} and seeds pod^{-1}. Further, interaction of fungicide with sowing depth and seed priming was non-significant for all the parameters studied, except nodule dry weight (Table 3).

Correlation study

Rainfall exhibited significant correlation with dry matter accumulation (at different time intervals) and yield and yield attributes of chickpea. The maximum and minimum temperature and sun shine hours were positively correlated with dry matter accumulation. The temperature (maximum and minimum) was negatively correlated with grain and biological yield of chickpea inferring that extreme maximum and minimum temperature adversely affected seed and biological yield in chickpea crop sown under rainfed conditions. Maximum and minimum temperature and relative humidity exhibited significant correlation with plant height, nodule weight and seed index (Table 4). Morning relative humidity was significantly correlated with yield attributes of chickpea, while evening relative humidity was significantly correlated with dry matter accumulation. Moisture is the main constraint in rainfed conditions and the chickpea crop appears to have taken moisture from humidity for better crop growth.

Relationship study

The height of chickpea plant increased with increase in nodule dry weight with the rate of 0.47 cm mg^{-1} plant^{-1} with accuracy of 93% (Fig. 2). The seed and biological yield was highly correlated with nodule dry weight. The nodule dry weight enhanced the seed yield of chickpea at the rate of 8.19 kg ha^{-1} mg^{-1} plant^{-1} with an accuracy of 87% (Fig. 3). But the nodule dry weight increased biological yield of chickpea

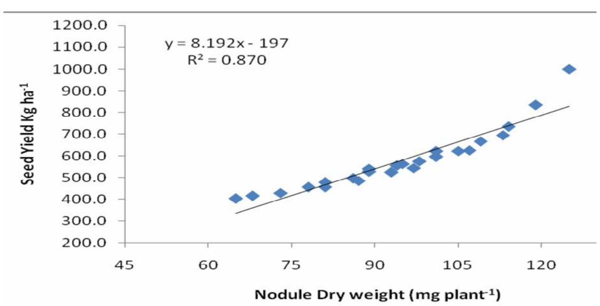

Fig. 3: Relationship between nodule dry weight and seed yield of chickpea

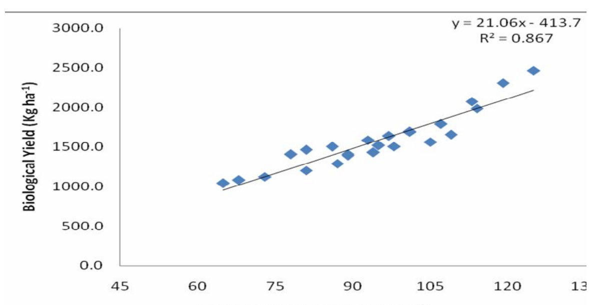

Fig. 4. Relationship between nodule dry weight and biological yield of chickpea

at a faster rate (21.1 kg ha^{-1} mg^{-1} $plant^{-1}$) with regression coefficient of 0.86 (Fig. 4). This showed that the seed and biological yield is highly dependent on nodule dry weight in chickpea crop.

REFERENCES

Anonymous. 2002. Pest management strategic plan for pulse crops (chickpea, lentil and dry pea) in the United States and Canada. pp. 5. ***In:*** *Summary of Workshop held on June 26-27, 2002,* Saskatoon, Canada.

Basra, S.M.A., Farooq, M. and Tabassum, R. 2005. Physiological and biochemical aspects of seed vigor enhancement treatments in fine rice (*Oryza sativa* L.). *Seed Science and Technology*, **33**: 25-29.

Bray, C.M., Davison, P.A., Ashraf, M., and Taylor, R.M. 1989. Biochemical changes during osmopriming of leek seeds. *Annals of Botany*, **63**: 185-193.

Chand, M., Singh, D., Roy, N., Kumar, V. and Singh, R. B. 2010. Effect of growing degree days on chickpea production in Bundelkhand region of Uttar Pradesh. *Journal of Food legumes*, **23:** 41-43.

Cumming, G. and Jenkins, L. 2011. Chickpea: Effective crop establishment. *Northern Pulse Bulletin PA, Pulse Australia*, 7: 2-3.

Gaur, P.M., Tripathi, S., Gowda, C.L.L., Ranga Rao, G.V., Sharma, H.C., Pande, S. and Sharma, M. 2010. *Chickpea Seed Production Manual.* ICRISAT, Patancheru, Andhra Pradesh, India.

Harris, D., Joshi, A., Khan, P.A., Gothkar, P. and Sodhi, P.S. 1999. On-farm seed priming in semi-arid agriculture: development and evaluation in maize, rice and chickpea in India using participatory methods. *Experimental Agriculture,* **35**: 15-29.

Harris, D. 1996. Effects of manure, genotype, seed priming, depth and date of sowing on the emergence and early growth of *Sorghum bicolor* (L.) Moench in semi-arid Botswana. *Soil and Tillage Research*, **40**:73–88.

Harris, D. 2006. 'On-farm' seed priming. A key technology to improve the livelihoods of resource-poor farmers in marginal environments (extended version). DFID/PSP information booklet, CAZS Natural Resources, University of Wales, Bangor, UK.

Lin, J.M. and Sung, J.M. 2001. Pre-sowing treatment for improving emergence of bitter gourd seedling under optimal temperatures. *Seed Science and Technology,* **29**: 39-50.

Malhotra, R.S., Singh, K.B. and Saxena, M.C. 1990. Effect of sowing on cold tolerance in chickpea. *International Chickpea Newsletter*, **22**: 19-21.

Saxena, M.C. and Singh, K.B. 1987. Agronomy of chickpea. pp. 207-232 ***In***: *The Chickpea* (Eds. M.C. Saxena and K.B. Singh). Wallingford, Oxfordshire, UK.

Siddique, K.H.M. and Loss, S.P. 1996. Deep sowing is beneficial to chickpea in Western Australia. *ICPN*, **3**: 31.

Singh, A.K., Singh, S.B., Singh, A.P. and Singh, V. 2010. Influence of sowing time on growth and yield of chickpea genotypes in hilly region of Jammu. *Journal of Food legumes*, **23:** 223-225