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On Farm Testing of Chickpea (*Cicer arietinum L.*) Cultivars for Site-specific Assessment under Rainfed Condition of Western Rajasthan

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ABSTRACT

To study the comparative performance of newly released as well as conventionally grown popular early, timely and late sown chickpea varieties, ten 'On Farm Assessment Trials (OFAT)' were conducted during Rabi 2008-09, 2009-10 and 2010-11 at various locations in arid region Pali district of Rajasthan. Results of 'OFAT' revealed that chickpea varieties viz. RSG-888 as well as RSG-991 were equally good performers under early sown conditions with respective average grain yields of 16.9 and 15.5 q/ha under rainfed. The variety GNG-1581 was tested under irrigated conditions and higher yield. Timely sown chickpea grown under rainfed conditions of Sumerpur, Raipur and Sojat blocks, RSG-896, GNG-1488, GNG-1292 and RSG-902 recorded grain yield ranging between 16.9 to 19.7 q/ha, while under irrigated conditions of Jaitaran and Sumerpur blocks, RSG-895, CSZD-884, Pratap-1 and RSG-807 performed better in terms of productivity and profitability with average grain yield ranging between 16.5 to 18.2 q/ha with highest yield in CSZD-884. The results under late sown rainfed chickpea indicated that GNG-469, GNG-663 and GNG-1958 recorded higher productivity over *deshi chana*, while new cultivars GNG-1969 was low performers under irrigated late sown conditions in terms of productivity and profitability over conventionally grown popular varieties GNG-469 and GNG-1958, respectively.

Keywords: Chickpea, technology, yield gap and rainfed

INTRODUCTION

Chickpea (*Cicer arietinum, L.*) is the premier pulse crop of Indian subcontinent. India is the largest chickpea producer as well as consumer in the world. India grows chickpea on about 8.56 million hectare area producing 7.35 million tons which represents 30 per cent and 38 per cent of the national pulse acreage and production, respectively. Chickpea production has gone up from 3.65 to 7.35 million tons between 1950-51 and 2010-11, registering a growth of 0.58 per cent annually (Anonymous, 2011). During the period, area has marginally declined from 7.57 to 6.67 million hectare and the productivity has steadily increased to 844 kg/ha from 482 kg/ha. There has been a major shift in the area of chickpea in the country. The expansion of irrigation facilities in northern India has led to replacement of chickpea with wheat and mustard in larger areas. As a result, the chickpea area reduced from 3.2 m ha to 1.0 m ha in northern states. Chickpea is one of the most important pulse crops of India in the traditional farming system.

Chickpea is cultivated over the entire Pali district of Rajasthan, which endowed with varied agro-climatic conditions varying from arid and semi-arid conditions to hot temperate high dry conditions. Most of the chickpea cultivated area falls under arid and semi arid condition in the district is rainfed except Sumerpur and Sojat blocks, which are under assured irrigation. The chickpea productivity in these irrigated areas is quite higher than rainfed areas of the district. Higher yield is related with the ability of genotypes to produce high amount of total dry matter which is responsible for better economic produce with the release of a number of new varieties in chickpea, it becomes important to find out the site-specific suitable varieties for early, timely and late sown rainfed as well as irrigated conditions of the district to harness their yield potential. With this background and objective, the present research study was conducted.

METHODOLOGY

In order to assess the site-specific performance, production potential and profitability of recently released chickpea varieties in comparison to popular and conventionally grown varieties in rainfed and irrigated conditions Pali district of Rajasthan, ten OFAT were conducted during rabi 2008-09, 2009-10 and 2010-11 on early sown, timely sown and late sown chickpea varieties at various locations following recommended package of practices (Anonymous, 2010). In order to assess the relative performance of early, timely and late sown chickpea cultivars under rainfed conditions, the rainfall data of Pali district of Rajasthan pertaining to chickpea growing months was obtained Table 1.

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Early sown chickpea

Under early sown conditions, two 'OFAT' were conducted. OFAT-I was conducted under early sown cultivars under rainfed conditions during rabi 2008-09 at village Dujana in Sumerpur block at one location using varieties RSG-888, RSG-991 and deshi in 0.40 ha area (Table 1). OFAT-II was conducted during Rabi 2009-10 in 0.40 ha area of variety GNG-1581 at five farmers' fields in villages Kushalpura in Raipur blocks of Pali district (Table 2).

Timely sown chickpea

Five OFATs were conducted during rabi 2008-09 to rabi 2010-11 as mentioned in Table 2. RSG-896 was tested under rainfed conditions at Dhola village of Sumerpur bolck during rabi 2008-09 (OFAT-III). Similarly, GNG-1488 and GNG-1292 were tested OFAT under rainfed conditions at Pipalia village of Raipur block in Pali district (OFAT-IV). RSG-902 was tested 'On Farm Assessment Trials' (OFAT-V) under rainfed conditions of Suraita village of Sojat block during Rabi 2010-11 at five farmers' field covering 0.40 ha area (Table 2). RSG-895 was tested under 'On Farm Assessment Trials' (OFAT-VI) under irrigated conditions during rabi 2010-11 in 0.40 ha area at five locations in five farmers' field of village Nimaj of Jaitaran block (Table 2). While CSZD-884, Pratap-1 and RSG-807 and were tested 'On Farm' (OFAT-VII) at Darri village in Sumerpur block at one location in 0.40 ha area under irrigated conditions.

Late sown chickpea

In order to assess the production potential of late sown chickpea cultivars , GNG-469 and GNG-663 were tested under 'On Farm Assessment Trial' under rainfed conditions at Pratapura village in Raipur block during rabi 2008- 09 (OFAT-VIII). Similarly, one popular chickpea variety was tested under 'On Farm Assessment Trial' under raifed conditions at Sandera village of Sumerpur block (OFAT-IX) during rabi 2009-10 in 0.40 ha area. GNG-1969 was tested under "On Farm Assessment Trial' (OFAT-X) under irrigated conditions in Nimbali village of Raipur block during rabi 2010-11 Table 2.

Table 1: Rainfall distribution in Pali district during rabi 2008-09 to rabi 2010-11

Month	Rainfall (mm)		
	2008-09	2009-10	2010-11
September	58.0	0.0	4.7
October	0.0	0.0	191.6
November	0.0	0.5	295.7
December	0.0	0.0	96.7

Table 2: Details of 'On Farm Assessment Trials' conducted on chickpea during rabi 2008-09 to 2010-11

OFAT	OFAT title	Season	Name of blocks/Villages	Treatment	Total area (ha)
A. Early sown chickpea varieties					
OFAT -I	Evaluation of recently released early sown varieties under rainfed conditions of Pali distract	Rabi 2008-09	Sumerpur Dujana	T_1=RSG-888 T_2=RSG-991 T3=Deshi	.40 .40 .40
OFAT -II	Evaluation of recently released early sown varieties under irrigated conditions of Pali distract	Rabi 2009-10	Raipur Kusalpura	T_1=GNG-1581 T_2=Deshi	.40 .40
B. Timely sown chickpea					
OFAT -III	Evaluation of newly releas ed timely sown varieties under rainfed conditions of Pali distract	Rabi-2008-09	Sumerpur Dhola	T_1=RSG-896 T_2=Deshi	.40 .40
OFAT -IV	Evaluation of recently released early sown varieties under rainfed conditions of Pali distract	Rabi-2009-10	Raipur Pipalia	T_1=GNG-1488 T_2=GNG-1292 T_3=Deshi	.40 .40 .40
OFAT -V	Evaluation of recently released early sown varieties under rainfed conditions of Pali distract	Rabi-2010-11	Sojat Suraita	T_1=RSG-902 T_2=Deshi	.40 .40
OFAT -VI	Evaluation of recently released early so wn varieties under irrigated conditions of Pali distract	Rabi-2010-11	Jaitaran Nimaj	T_1=RSG-895 T_2=Deshi	.40 .40
OFAT - VII	Evaluation of recently released early sown varieties under irrigated conditions of Pali distract	Rabi-2010-11	Sumerpur Darri	T_1=CSZD-884 T_2=Pratap-1 T_3=RSG-807 T_4=deshi	.40 .40 .40 .40

RESULTS AND DISCUSSION

Early sown chickpea

Data presented in Table 3 revealed that RSG-888 out yielded RSG-991 and *deshi channa* (control) in an 'On Farm Trial' (OFAT-I) under rainfed conditions of Pali district during rabi 2008-09. Yield increase in RSG-888 and RSG-991 over deshi channa (control) was 48.24 and 35.96 per cent, respectively. The gross and net returns as well as benefit: cost ratio also followed the similar trend as that of grain yield. Net returns in case of RSG-888, *RSG*-991 and *deshi channa* were ₹ 26100, 24100 and 11100 per hectare, respectively with respective B: C ratio of 2.7:1, 2.5:1 and 1.2:1 in the above OFAT-I (Table 3). While under irrigated conditions in OFAT-II conducted at 5 locations (Table 2), GNG-1581 were found to be superior over *deshi channa* in terms of grain yield, gross and net returns as well as benefit: cost ratio during rabi 2009-10 with average grain yield of 17.3 and 10.7 q/ha

and net returns of ₹ 25800 and 10500 per hectare, respectively (Table 3). GNG-1581 is recently recommended varieties of chickpea for early sown irrigated conditions of arid zone of Rajasthan (Anonymous, 2010). Both in OFAT-I and OFAT-II, it was revealed that RSG-888 as well as GNG-1581 were equally good performers under rainfed and irrigated early sown conditions of arid region of Pali district of Rajasthan.

Table 3: Production and productivity of chickpea cultivars under early/timely/late sown conditions under 'On Farm Assessment Trials'

Sl. No.	Cultivars/farming situation	Grain yield (q/ha)	Yield increase over control (%)	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
A.	Early sown chickpea						
OFAT -I	One location/ Season: Rabi -2008-09/Farming situation : Rainfed						
T_1	RSG-888	16.9	48.24	9500	35600	26100	2.7
T_2	RSG-991	15.5	35.96	9500	33600	24100	2.5
T_3	*Deshi* (Control)	11.4	-	9000	20100	11100	1.2
OFAT - II	Five location/ Season: Rabi -2009-10/Farming situation: Irrigated						
T_1	GNG-1581	17.3	61.68	10500	36300	25800	2.5
T_2	*Deshi* (control)	10.7	-	9000	19500	10500	1.2
B.	Timely sown chickpea						
OFAT - III	One location/ Season: Rabi -2008-09/Farming situation: Rainfed						
T_1	RSG-896	19.7	65.54	9500	39500	30000	3.2
T_2	*Deshi* (Control)	11.9	-	9000	20900	11900	1.3
OFAT - IV	One location/ Season: Rabi -2009-10/Farming situation: Rainfed						
T_1	GNG-1488	18.5	79.61	9500	38500	29000	3.0
T_2	GNG-1292	17.3	61.68	9500	36300	26800	2.8
T_3	*Deshi* (control)	10.3	-	9000	19900	10900	1.2
OFAT - V	Five location/ Season: Rabi -2010-11/Farming situation: Rainfed						
T_1	RSG-902	16.9	56.48	9500	39050	29550	3.1
T_2	*Deshi*	10.8	-	9000	18500	95000	1.0
OFAT - VI	Five location/ Season: Rabi -2010-11/Farming situation: Irrigated						
T_1	RSG-895	17.4	61.11	10500	40100	29600	2.8
T_2	*Deshi* (control)	11.3	-	9000	19500	10500	1.2
OFAT -	One location/ Season: Rabi -2010-11/Farming situation: Irrigated						

Timely sown chickpea

Data presented in Table 3 on OFAT-III revealed that RSG-896 were good performers over *deshi chana* under rainfed timely sown conditions in terms of grain yield, gross and net returns as well as B:C ratio during rabi 2008-09. While in another 'On Farm Trial' (OFAT-IV) conducted under rainfed conditions during rabi 2009-10, it was revealed that GNG-1488 out yielded the GNG 1292 and *deshi chana* by 61.68 per cent and 79.61 per cent, respectively with grain yield of 18.5 q/ha and 17.3 q/ha. Net returns in case of GNG-1488, GNG-1292 and *deshi chana* (control) were ₹ 29000, 26800 and 10900 per hectare, respectively with respective B: C ratio of 3.0 : 1, 2.8 : 1 and 1.2:1 in the above OFAT-IV (Table 3). In OFAT-V conducted under rainfed conditions of at five locations during rabi 2010-11 (Table 3), RSG-902 was found to be superior over deshi chana (control) with 56.48 per cent higher grain yield as well as higher gross and net returns. RSG-902 and deshi chana registered grain yield of 16.9 and 10.8 q/ha, gross returns of ₹ 39050 and 18500 per hectare, net returns of ₹ 29550 and 95000 per hectare with B: C ratio of 3.1 and 1.0, respectively (Table 3).

In 'On Farm Trial' conducted under irrigated conditions of Jaitaran block at five locations (OFAT-VI) during rabi 2010-11 (Table 3), variety RSG-895 was found to be superior over deshi chana (control) with 61.11 per cent higher productivity and gross returns 76.55, and 49.8 per cent higher net returns. RSG-895 and deshi registered average grain yield of 17.4 and 11.3 q/ha, net returns of ₹ 29600 and 10500 per hectare with B: C ratio of 2.8 and 1.2, respectively (Table 3). Under OFAT-VII conducted in irrigated conditions Table 3, CSZD-884 observed higher grain yield (18.2 q/ha) followed by Pratap-1, RSG-807 and deshi chana, respectively in Sumerpur block during rabi 2010-11. Gross and net return as well as B: C ratio also followed similar trend in the present study. Yield increase in CSZD-884 and Pratap-1 over deshi chana (control) was 71.70 and 67.92 per cent, respectively while RSG-807 registered 55.66 per cent lower yield than CSZD-884 Table 3.

'On Farm Assessment Trials' conducted in timely sown chickpea conclusively inferred that under rainfed conditions of Sumerpur, Sojat and Raipur blocks, RSG-896, GNG-1488 and RSG-902 can yield to 19.7, 18.5 16.9 q/ha under recommended agronomic practices. While under irrigated conditions of Sumerpur and Jaitaran blocks, RSG-895, CSZD-884, Pratap-1 and RSG-807 performed better than deshi chana in terms of productivity and profitability with the average grain yield of these cultivars varied between 16.5 to 18.2 q/ha with highest magnitude in CSZD-884 and least in deshi chana, respectively. These results further revealed that all the timely sown chickpea cultivars performed well under rainfed as well as irrigated conditions resulting into economically acceptable crop yields except deshi (OFAT-III-VII) under rainfed conditions because of poor rainfall during mid October during rabi 2008-09 to 2010-11 (Table1) resulting in poor moisture at early growth stage critical for optimum crop stand which resulted in economically unacceptable crop yield Table 3.

Late sown chickpea

Data pertaining to OFAT-VIII Table 3 revealed that GNG-469 and GNG-663 produced 72.38 per cent and 66.04 per cent higher grain yield over conventionally grown larger area chickpea variety of deshi chana (control), respectively under late sown rainfed conditions in Pratapura village of Raipur block during rabi 2008-09. GNG-469, GNG-663 and deshi chana yielded grain yield of 18.9, 17.6 and 10.5 q/ha with respective gross and net returns of ₹ 36900, 39700, 18800; and ₹ 27400, 30200 and 9800 per hectare Table 3. In OFAT-IX conducted under rainfed conditions in Sandera village of Sumerpur block during rabi 2009-10 Table 2, it was revealed that GNG-1958 already a popular variety of the area was found to be superior over deshi chana with 67.59 per cent higher grain yield as well as higher gross and net returns. GNG-1958 and deshi chana registered grain yield of 18.1 and 10.8 q/ha, respectively though the respective net returns were ₹ 29800 and ₹ 10400 per hectare besides B: C ratio of 3.1 and 1.2 Table 3.

In OFAT-X conducted during rabi 2010-11 under late sown irrigated conditions of Nimbali village in Raipur block (Table 2), GNG-1969 registered 23.27 per cent higher yield over variety of deshi chana (control). GNG-1969 and deshi yielded grain yield of 14.3 and 11.6 q/ha with respective gross and net returns of ₹ 30000 and 19200; and ₹ 19500 and 10200 per hectare with respective B: C ratio of 1.9:1 and 1.1:1 (Table 3). The results under late sown chickpea indicated that GNG-1969 (OFAT-X) under late sown irrigated conditions could not perform well resulting in unacceptable crop yields in terms of profitability because of poor rainfall during mid December during rabi 2010-11 (Table 1) resulting in poor moisture at sowing and early growth stage critical for optimum crop stand and yield expression. Similarly, GNG-469 and GNG-1958 both conventionally grown popular varieties even under rainfed conditions (OFAT-VIII & OFAT-IX) were to produce economically acceptable crop yields, though new cultivars GNG-663 comparatively good performers under rainfed late sown conditions in terms of productivity and profitability in conditions in all blocks of Pali district. The findings confirm with the findings of Ashiwal and Hussain (2008), Chandra, *et al*. (2012), Choudhary, *et al*. (2010),

Kumawat (2008), Jeengar, *et al*. (2006), Malhotra, *et al*. (1987), Meena and Singh (2011), Narwale, *et al*. (2009), Padmaianh and Venkattakumar (2009), Purushottam, et al. (2012), Singh, *et al*. (2009), Singh, *et al*. (2011), Tomar, *et al*. (2009) and Yadav *et al*. (2007).

CONCLUSION

It may be concluded that the results of On Farm Assessment Trials helped to infer that RSG-888 and GNG-1581 are equally good performers under rainfed and irrigated early sown conditions of arid region of Pali district. Under timely sown rainfed conditions of Sumerpur, Raipur and Sojat blocks, the cultivars namely RSG-896, GNG-1488, GNG-1292 and RSG-902 yielded 19.7, 18.5, 17.3 and 16.9 q/ha, respectively. While under irrigated conditions of Sumerpur and Jaitaran blocks, CSZD-884, Pratap-1, RSG-895 and RSG-807 performed better in terms of productivity and profitability with average grain yield ranging between 16.5 to 18.2 q/ha with highest magnitude in RSG-807, respectively. The results under late sown rainfed chickpea indicate that GNG-469 yielded higher productivity over new cultivar GNG-663, while new cultivars GNG-1958 were good performers under irrigated late sown conditions in terms of productivity and profitability over conventionally grown popular varieties GNG-1969 and deshi chana in arid condition Pali district of Rajasthan.

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