Indian J. Genet., 70(1): 91-93 (2010)

Short Communication

Pyramiding of drought avoidance/tolerance mechanisms - earliness, root weight and root length through multiple introgression in chickpea (*Cicer arietinum* L.)

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(Received: aUGUST 2009; Revised: dECEMBER 2009; Accepted: jANUARY 2010)

In chickpea (*Cicer orietinum*) the terminal drought is a major constraint that limits the productivity. Efforts to breed drought tolerant varieties in the past have not been rewarding because of imperfect understanding of drought manifestation using yield as an empirical selection criterion [1]. Plant breeders have categorized this drought tolerance mechanism in three categories *viz*. drought escape (early phonology of ICCV-2), drought avoidance by reduced leaf area and narrow leaflets (ICCV-10448) and drought tolerance through large root mass (ICCV-4958) [2]. Present investigation was therefore planned to introgress these different mechanism using three breeding lines (ICCV-2, ICCV-4958 and ICCV-10448) as a source for one or the other mechanism of drought tolerance in to agronomically preferred variety Annigiri (A-1). Evaluation of breeding population was done during *rabi* season of 2004. There was typical drought situation during that year as there were no rainfall during croping period of chickpea.

The experimental material consisted of four parents A-1, ICCV-2, ICCV-4958, ICCV-10448 and F_2's of four three way cross hybrids (A-1 x ICCV-2 x ICCV-4958, A-1 x ICCV-4958 x ICCV-10448, ICCV-2 x ICCV-4958 x ICCV-10448, A-1 x ICCV-2 x ICCV10448), one double cross hybrid [(A-1 x ICCV-2) x (ICCV-4958 x ICCV-10448)]. The F_2's generation of the above mentioned crosses were planted to asses their potentiality and abiotic stress tolerance. The experiment was laid out at Agriculture Research Station Gulbarga during *rabi* 2004. Trenches of 30 cm width with 100 cm deep were dug at 60cm distance. The perforated polythene bags of 100 cm length with 15cm diameter was filled with soil mixed with nutrients as per the agronomic package. The filled polythene bags were buried in row along the trenches during April, 2004. The seeds were sown in the buried bags. From the month of June to September they were allowed to saturate with rain water [3]. Observations were recorded on each parent and 100 F_2's grown in polythene bag (buried in the earth) for seed yield (g), days to flowering and pods per plant. The F_2 segregants with values better than the value of A-1 mean + 2σ were selected and the best performing progeny were selected during 2004 *rabi* under rainfed condition. Further the polythene bags with plant were excavated and soil in the bag was washed without disturbing the root system. Then the root length (cm) and dry root weight (g) was recorded.

Drought is a very complex trait [4]. The tolerance to drought should ultimately show up in higher economic yield which is the ultimate aim. Therefore in the present study, the improvement of drought tolerance sought by converging different mechanisms of drought tolerance and escape has been measured in terms of mean, range and variance of seed yield, and five of its most important component traits i.e. pod number, seed weight, root length, root weight and days to flowering. The national check, Annigiri (A-1) is a moderately drought tolerant variety, however, yield losses are significant in this variety TOO. Therefore an attempt has

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Table 1. Mean performance of superior F_2 segregants as compared with parents in respect of seed yield and its component characters and root traits in chickpea

S. No.	Crosses/ parents	P.N.	DF	PPP	SW	RW	RL	SY (>A-1 mean+2σ)
1	A-1 X ICCV-2 X ICCV-4958	9	44	210	15.00	1.80	81	110.00
2	A-1 X ICCV-2 X ICCV-4958	12	38	425	27.00	4.60	100	160.00
3	A-1 X ICCV-2 X ICCV-4958	16	44	300	43.70	3.60	83	120.00
4	A-1 X ICCV-2 X ICCV-4958	28	38	380	38.40	3.16	100	130.00
5	A-1X ICCV-2 X ICCV-10448	36	38	365	20.00	2.04	46	100.62
6	A-1X ICCV-2 X ICCV-10448	51	47	380	19.26	3.80	100	100.81
7	A-1 X ICCV-4958 X ICCV - 10448	42	53	347	18.80	2.78	92	95.63
8	A-1 X ICCV-4958 X ICCV - 10448	43	44	458	18.70	2.88	93	105.38
9	A-1 X ICCV-4958 X ICCV - 10448	66	46	405	17.00	3.09	92	91.71
10	A-1 X ICCV-4958 X ICCV - 10448	81	44	458	18.70	3.38	95	105.38
11	ICCV-2 X ICCV-4958 X ICCV-10448	4	38	220	25.20	1.08	72	66.00
12	ICCV-2 X ICCV-4958 X ICCV-10448	18	54	395	15.20	3.04	78	86.00
13	ICCV-2 X ICCV-4958 X ICCV-10448	23	47	403	10.00	2.69	83	90.00
14	ICCV-2 X ICCV-4958 X ICCV-10448	25	54	303	26.00	2.00	68	76.00
15	A-1 X ICCV-2 X ICCV-4958 X ICCV-10448	20	46	357	38.11	4.01	92	150.00
16	A-1 X ICCV-2 X ICCV-4958 X ICCV-10448	79	38	470	25.00	2.88	98	103.62
17	A-1		45.3	146.4	19.31	1.14	69.3	46.0
18	ICCV-2		41.9	92.3	25.10	1.04	34.8	38.8
19	ICCV-14958		45.9	86.8	25.10	1.51	56.8	41.5
20	ICCV-10448		46.9	153.7	16.9	1.0	4.45	29.88

DF: (Days to flowering): PPP: (Pods/plant): SW: (Seed weight): RW: (Root weight): RL: (Root lenght): SY: (Seed yield/plant) PN: (Plant number)

been made to identify high yielding segregants under drought condition. Accordingly, the genotypes have been chosen in such way that they contribute different mechanism of drought tolerance which can be ultimately combined in a single genotype by pyramiding individual component traits. In the present study the segregants are selected with a criterion that their performance is better than the value of A-1mean + 2σ of the entire population. Sixteen promising segregants with several drought tolerance mechanism are presented in Table 1. Of these, 14 were three way cross derivatives and rests were double cross derivatives. All the four parents appear to be equally important, however, ICCV-4958 that contributed for root biomass appeared to be the important one.

Further, the four derivatives combining three way cross combination involving A-1, ICCV-2 and ICCV-4958 all exceeded the overall F_2 mean seed yield ranging from 110 to 160 gm. These combinations appeared to have the optimum combination of earliness as well as root weight and root length. The other possible combination of the mechanism involving reduced transpiration loss and dry root weight biomass appeared to be not promising as reflected by the seed yield. It is therefore evident that combination of these mechanism involving earliness and root mass is better compared to that of root mass and reduced transpiration loss. The derivatives of the double cross combinations exceeded the overall F_2 mean and appeared to combine all the three mechanisms that is earliness, root biomass and high number of pods optimally. Thus, pyramiding of earliness and high root mass appeared to be more beneficial in breeding for high productivity with drought tolerance.

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