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Effect of production constraints on seed yield and Economics of chickpea (*Cicer arietinum* L.)

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Abstract
A field experiment was conducted during *Rabi* season of 2020-2021 at Experimental Farm, Department of Agronomy, College of Agriculture, Latur. To assess the effect of different production constraints on productivity of chickpea. The soil of experimental plot was clay in texture, moderately alkaline in reaction having pH (7.04) with chemical composition such as available nitrogen (231 kg ha^{-1}), very low in available phosphorous (8.55 kg ha^{-1}) and very high in available potassium (580 kg ha^{-1}). It was well drained and favorable for optimum crop growth. The experiment was laid out in Randomized Block Design with eight treatments. The treatments were T1: Full package of practices, T2: T1-RDF, T3: T1-Weeding, T4: T1 - Plant protection, T5: T1 - (RDF + Weeding), T6: T1 - (RDF + Plant protection), T7: T1 - (Weeding + Plant protection), T8: T1 - (RDF + Weeding + Plant protection). The gross and net plot size of each experimental unit was 5.4 m x 4.5 m and 4.8 m x 3.9 m, respectively. Sowing was done on 9th November 2020 by dibbling method with seed rate of 50 kg ha^{-1}.
The result showed that application of Full package of practices (T1) was found most effective for increasing productivity of chickpea. Among the different treatments, application of full package of practices (T1) was found beneficial in increasing yield attributing characters, seed yield and economics of chickpea than RDF alone or combination with Weeding or Plant protection, respectively. Application of full package of practices (T1) was superior in respect of gross and net monetary returns and followed by T4. However higher B:C ratio (3.00) was recorded with the application of full package of practices (T1).

Keywords: Chickpea, RDF, weeding, plant protection, yield

Introduction
Chickpea (*Cicer arietinum* L.) is a major pulse crop of *Rabi* season belongs to the family 'Fabaceae' and grown worldwide as a food crop. Chickpea is cheap and important source of protein for afford animal protein or who are largely vegetarian. Chickpea is also a good source of minerals, unsaturated fatty acids and fiber. Chickpea is also playing an important role in maintaining soil fertility by fixing nitrogen @ up to 140 kg/ha/year (Flowers *et al*. 2010) [7]. Chickpea crop requires relatively low inputs of nitrogen as it derives 70% of its N through symbiotic N2 fixation and benefits other cereal crops as well (Siddique *et al.,* 2005) [15]. Chickpea is one of the oldest legume crops and is consumed widely across the world.
In India Chickpea occupying 10.56 million hector area, with production 11.23 million tonnes and yield 1063 kg ha^{-1}. India ranks 1st in the world with respect to production as well as acreage followed by Australia with two million metric tonnes of chickpea. Maharashtra occupying area about 19.22%, production 15.57%, while Marathwada region having 10.59 lakh hectare area with the production of 7.96 lakh tonnes with the productivity of 760.56 kg ha^{-1} (Anonymous, 2019) [1].
Hence efforts are to be made to boost up to the yield per hectare of chickpea Production constraints refer to the limitations on cultural operation and basic inputs of agriculture like weeding, fertilizers and plant protection that are necessary for better growth and development of crop, higher yield and economic benefits. Though the input management had been given due importance to the per cent contribution or the losses due to their non-availability to the pulse crop are yet to be investigation quantified.

Materials and Methods
The field experiment was conducted during *Rabi* season of 2020-21 at Experimental Farm, Department of Agronomy, College of Agriculture, Latur. The soil of experimental plot was medium and black in color with good drainage. Chemical composition of soil such as low in

available nitrogen (231 kg ha^{-1}), very low in available phosphorous (8.55 kg ha^{-1}) and very high in available potassium (580 kg ha^{-1}). The soil was moderately alkaline in reaction having p^H (7.04). The experiment was laid out in Randomized Block Design with three replications and eight treatments i.e. T1 (Full Package (RDF + Weeding + Plant protection), T2 (T1–RDF), T3 (T1 – Weeding), T4 (T1 - Plant protection), T5 (T1 - (RDF + Weeding), T6 (T1 - (RDF + Plant protection), T7(T1 - (Weeding + Plant protection), T8 (T1 - (RDF + Weeding + Plant protection). The gross plot size each experimental unit was v 5.4 mx 4.5 m and net plot size was 4.8 m x 3.9m Sowing is done by dibbling method at spacing 30cm x 10cm on 9th November, 2020. The recommended dose of fertilizers was 25:50:30 kg NPK ha^{-1}. A popular chickpea variety in Marathwada region, BDNG-797 (Akash), was used in the present study. The fertilizers were applied as per treatments at the time of sowing. The sources of nitrogen, phosphorus and potassium were urea, DAP and MOP, respectively. Harvesting was done on 23rd February, 2021.

Results

Per cent reduction of Chickpea yield over full package of practices

The percent reduction in yield due to various resource constraints over full package of practices was calculated and presented in Table 1.

The maximum reduction in seed yield (60%) was observed when RDF, weed management and plant protection was not adopted (T8) followed by T5 (48.15%), T6 (40%), T7 (36.43%), T2 (27.24%), T3 (19.40%) and T4 (13.51%). The full package of practices (FPP) reported maximum seed yield of chickpea (2515 kg ha^{-1}). Treatment T8 where RDF application, weed management and plant protection these three factors combination was lacking resulted in decrease in chickpea seed yield up to 60% as in contrast to FPP (T1) and this treatment determined to be as a predominant resource constraint in chickpea production. This was followed by two factor production constraints, RDF with weeding (T5), RDF with plant protection (T6) and weed management with plant protection (T7) and caused yield losses of chickpea up to 48%, 40% and 36% respectively. Among the different constraints of the single production factor, RDF was found to be the most crucial factor caused yield losses of up to 27%, followed by weeding (19%) and plant protection (13%) as compared with full package of practices.

Similar results have been reported by Srivastava (2003), Singh *et al.* (2011), Bhan *et al.* (1991), Jain *et al.* (2002), Choudhary *et al.* (2005) and Maurya *et al.* (2008) [19, 17, 2, 8, 4, 12].

Seed yield (kg ha^{-1})

Data relating to seed yield (kg ha^{-1}) as influenced by different treatments are presented in Table 2. The average seed yield of chick was1750 kg ha^{-1}. With the use of full package of practices (T1) a significantly higher seed yield (2525kg ha^{-1}) was recorded and significantly superior over the rest of the treatments. The lowest seed yield (1010 kg ha^{-1}) was recorded with the treatment T8 where RDF, weeding and plant protection were excluded.

Gross and Net monetary returns (Rs/ha^{-1})

Data on the Gross monetary returns (GMR), Net monetary returns (NMR), B:C ratios as influenced by various treatments are presented in Table 2. The mean gross and net monetary return of chickpea was recorded as Rs. 85756 $ha^{-1}$and Rs. 52671 ha^{-1} respectively. The mean benefit: cost ratio was observed as 2.53.

The gross and net monetary return was influenced significantly due to various treatments. Significantly highest gross (Rs. 123235 ha^{-1}) and net (Rs. 82270 ha^{-1}) monetary return was obtained with the application of full package of practices (T1). This treatment was found significantly superior over rest of all the treatments while treatment T8 (no RDF, weeding and plant protection) gave significantly lowest gross (Rs. 49490 ha^{-1}.) and net (Rs. 24190 ha^{-1}) monetary return.

Benefit: Cost ratio

Data in respect of B:C ratios as influenced by different treatments are presented in Table 2. The mean benefit: cost ratio was observed as 2.53. The higher B:C ratio (3.00) was observed with the full package of practices (T1) followed by T4 with B:C ratio 2.88 where plant protection was not done, whereas treatment T8 (no RDF, weed control and plant protection) and T5 (no RDF and weed control) was recorded lowest B:C ratio (1.95 and 2.18 respectively).

The treatment T1 with application of full package of practices (FPP) where RDF application, complete weed management and plant protection were applied, reported maximum gross (Rs. 123235 ha^{-1}) and net (Rs. 82270ha^{-1}) monetary returns due to increment in dry matter and maximum seed yield which was followed by the treatment T4 (Rs. 106575 ha^{-1}) where plant protection was excluded and lowest gross (Rs. 49490 ha^{-1}) and net (Rs. 24190 ha^{-1}) monetary returns due to high weed and pest infestation and missing of RDF and likewise highest Benefit: Cost ratio was reported with full package of practices (T1).

Similar results have been reported by Singh *et al.* (2017), Roysharma *et al.* (1991), Mahapatra *et al.* (1995), Rajkhowa *et al.* (2002), Kumar *et al.* (2002), Singh *et al.* (2011), Elamin *et al.* (2015), Kachave *et al.* (2018) and Chattha *et al.* (2007) [18, 14, 11, 13, 10, 17, 6, 9, 3].

Table 1: Per cent reduction of chickpea yield over full package of practices

Treatments	Seed yield (kg ha^{-1})	Reduction in yield (%)
T1: Full Package	2515	-
T2: T1 – RDF	1837	27.24
T3: T1 – Weeding	2035	19.40
T4: T1 - Plant Protection	2175	13.51
T5: T1 - (RDF + Weeding)	1309	48.15
T6: T1 - (RDF + Plant Protection)	1515	40.00
T7: T1 - (Weeding + Plant Protection)	1605	36.43
T8: T1 - (RDF + Weeding + Plant Protection)	1010	60.00
General Mean	1750	34.96

Table 2: Mean Seed yield (Kg/ha^{-1}), Gross return (Rs. ha^{-1}), Cost of cultivation (Rs. ha^{-1}), Net return (Rs ha^{-1}) and B:C ratio of chickpea as influenced by various treatments

Treatments	Seed yield (kg ha^{-1})	Gross Return (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net Return (Rs. ha^{-1})	B:C Ratio
T1: Full Package	2515	123235	40965	82270	3.00
T2: T1 – RDF	1837	90013	35400	54671	2.54
T3: T1 – Weeding	2035	99715	34965	64750	2.85
T4: T1 - Plant Protection	2175	106575	36965	69910	2.88
T5: T1 - (RDF + Weeding)	1309	64147	29400	34747	2.18
T6: T1 - (RDF + Plant Protection)	1525	74235	31400	42835	2.36
T7: T1 - (Weeding + Plant Protection)	1605	78645	30965	47680	2.53
T8: T1 - (RDF + Weeding + Plant Protection)	1010	49490	25300	24190	1.95
SE +	102.6	4364	-	4364	-
C.D. at 5%	309	12237	-	12237	-
General Mean	1750	85756	33170	52671	2.53

Conclusion

The highest seed yield (2515 kg ha^{-1}), gross monetary returns (₹ 123235 ha^{-1}), net monetary returns (₹ 82270 ha^{-1}) and B:C ratio (3.00) was recorded with application of full package of practices (T_1), while the lowest gross and net monetary returns and B:C ratio was recorded with T8 where RDF, weed management and plant protection were missing from full package of practices and notified as a major resource constraint in Chickpea production.

Regarding the combination of three factor production constraints, RDF, weed management and plant protection caused a reduction in yield of 60% as compared to T1 (Full Package Practices) and was reported as a major resource constraint in chickpea production, followed by two factor production constraints RDF with weeding (T5), RDF with plant protection (T6) and weed management with plant protection (T7) and caused yield losses of up to 48%, 40% and 36%, respectively.

Among the different constraints of the single production factor, RDF was found to be the most crucial factor caused yield losses of up to 27%, followed by weeding 19% and plant protection 13% as compared with full package of practices. Therefore, RDF is suggested to apply on a priority basis followed by weeding and plant protection to Chickpea crop.

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