An ideotype for chickpea (Cicer Arietinum L.) in a dry mediterranean environment

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Seed yields of chickpea are low (world average 623 kg ha^{-1}), compared to many other crops. The concept of specific plant types, as in cereals and field peas has received little attention in chickpeas. Our data from an earlier study (1) supported other studies (2) which show that reduced harvest index (HI) of chickpea at higher densities tends to compensate for increased biological yield, resulting in little change in grain yield. In high density stands of freely branching plants branch number did not decline, but later branches competed poorly with earlier branches for resources needed to form reproductive sites and seed forming structures. The result was that HI of later branches, and hence their yield, and crop yield were reduced. We proposed that seed yield in chickpea is controlled by the HI of branches and that seed yields might be raised by restricting branches in high density stands to no more than two, each with a high harvest index. In 1933 we tested this on a heavy soil, at Merredin in the southwestern Australian cereal belt.

Methods

Chickpea seeds (CPI.56288) (originally supplied by E.J. Knights, Wagga Wagga Agricultural Research Institute, N.S.W. Department of Agriculture) were planted on June 16, 3-4 cm deep, at a spacing of 20 cm between the rows and 7 cms within the rows to give a plant density of 70 plants m^{-2}. The design was a randomised block with 5 replicates; plot size was 4 x 3 m with 15 rows per plot. The treatments were a control, in which plants were allowed to branch freely, and a debranched, in which all branches except the mainstem and first formed branch were cut off as soon as they were 3-4 cm long. Debranching was done on 43, 57 and 77 DAS, after which very little regrowth of basal branches occurred. Growth, development and dry matter production of component branches and whole plants were recorded at 15 day intervals until final harvest, when seed yield, yield components and HI of component branches, whole plant and crop were also recorded. Seasonal water use and leaf water potential were measured.

Results and Discussion

The debranched treatment reduced the total leaf number and soil cover in the pre-flowering period and increased the leaf number, LAI and dry matter in the post-flowering period. Debranching also increased the number of apical branches, flowers, pods and seeds, and reduced pod abortion per branch as well as per unit area. Apical branches are small branches formed on the apical nodes of mainstem and basal branches which carry flowers, pods and set seeds. Total water-use was the same, with the control using more water before, and less after, flowering, than the debranched. Table 1 shows that the resultant effect was to increase seed yield and HI of the debranched treatment.

Table 1 - Effect of debranching on seed yield, biological yield (t ha^{-1}) and HI of chickpea (CPI.56288).

Particulars	Treatment		L S D	
	Control	Debranched	P = 0.05	p = 0.01
Seed Yield	1.35	1.87	0.23	0.38
Bio. Yield	5.35	5.55	1.13	1.87
Harvest Index	0.26	0.34	0.04	0.07

Our data support the concept of raising yields in chickpea by growing reduced branching types in high density stands in short season mediterranean environments such as Merredin. Sparse branching may well be found in existing germ- plasm. Evaluation of reduced branching at high densities in also warranted in other grain legumes, such as lupins, which have low harvest indices.

1. Siddique, K.H.M., Sedgley, R.H., and Marshall, C. (1984). Field Crops Research. 9:193-203

2. Headley, CA., and Ambrose, M.J. (1981). Adv. Agron. 34:225-277.