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EFFECTS OF POD EXPOSURE ON YIELD OF CHICKPEAS (*CICER ARIETINUM*)

N.P. SAXENA and A.R. SHELDRAKE

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad - 500016, A.P. (India)

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ABSTRACT

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Pod photosynthesis is known to contribute to seed filling in a number of legume crops, and may also be of importance in chickpeas (*Cicer arietium* L.), which have green pods possessing stomata. Although the pods of chickpeas are borne in the leaf axils, they generally hang below the leaves and are consequently more or less shaded; but a few lines have recently been identified in which the pods are borne above the leaves. This "exposed pod" character could be incorporated into new cultivars by breeding if it were shown to be of advantage. The effect on yield and yield components of exposing pods of normal cultivars was investigated in field experiments at three locations in India: at Hyderabad and Hissar during the winter season, and in the Lahaul valley in the Himalayas during the summer season. A significant effect of pod exposure on yield or yield components was not observed in any of the experiments, except at Hissar where a slight but significant increase in 100-seed weight was noted. The "exposed pod" character is unlikely to be of use in breeding for higher yield potentials.

INTRODUCTION

Photosynthesis in the pods of a number of legume species is known to result in the fixation of carbon dioxide released by respiring seeds as well as from the atmosphere, and to play a significant role in the supply of photoassimilates for seed development (Flinn and Pate, 1970; Crookston et al., 1974; Quebedeaux and Chollet, 1975; Pate et al., 1977). It seems probable that the pods of chickpeas (*Cicer arietinum* L.), which are green and possess stomata, are also capable of photosynthesis. These pods are normally subtended below the leaves and are consequently more or less shaded.

In field experiments, we kept the pods above the leaves in order to test the possibility that exposure to higher light intensities might lead to greater yields through enhanced pod photosynthesis. A number of chickpea lines in which the pods are held above the leaves have recently been identified at ICRISAT and if exposed pods are of advantage in chickpeas, it should be possible to incorporate this character into new cultivars.

MATERIALS AND METHODS

Experiments were carried out in the field at these locations in India: on a Vertisol (fine clayey, Typic Chromustert) in peninsular India at ICRISAT Center, near Hyderabad; on an Entisol (sandy, Typic Camborthids) at Hissar in northern India; and on an Entisol (sandy loam, Typic Eutrochrets) at Dalang (altitude 3140 m) in the Lahaul valley of the western Himalayas. In all cases the soil was fertilized with superphosphate (50 kg/ha P_2O_5) before sowing. At the ICRISAT Center the trial was sown on 7 November 1975 and harvested on 5 March 1976; at Hissar sowing was on 31 October 1976 and harvest on 22 April 1977; at Dalang sowing was on 19 May 1975 and harvest on 26 September 1975.

At all locations the experiment was carried out in a split plot design (four replications) with the cultivars in the main plots and pod exposure treatments in the subplots. At ICRISAT Center cvs '850-3/27', 'L-550', 'Pant-102', and 'BEG-482' were used; at Hissar cvs '850-3/27', 'L-550', 'G-130', and 'H-208'; at Dalang cvs '850-3/27', 'L-550' 'Pant-120', and 'T-3'. At the three locations the subplot sizes were 3 × 3 m, 2 × 1.8 m, and 3 × 2.4 m respectively. Seeds were sown by hand at a spacing of 30 × 10 cm with two seeds per hill; the seedlings were thinned to one per hill and protected against insect pests by sprays of endosulfan.

The pod exposure treatment involved hooking the pods onto the upper surface of leaves at nodes immediately distal to those subtending the pods. This treatment did not damage the pods and, once shifted, the pods remained in this exposed position. The treatment was started at the beginning of the pod-filling period and was repeated at frequent intervals as new pods developed. The control plants were untreated.

At harvest, the border rows were discarded and the total shoot dry weight and yield of all the remaining plants recorded. Yield components were measured in a sample of ten plants per subplot. Air dry weights of the harvested plants were corrected to oven-dry weights on the basis of data from the ten-plant sample from each subplot.

In the statistical analyses, treatment × cultivar interactions were non-significant in all experiments and therefore only data for treatment means are presented.

RESULTS AND DISCUSSION

In none of the experiments was the yield significantly affected by the exposure of the pods (Table I). Nor was there a significant effect on total shoot dry weight, pod number per plant, seed number per pod, or 100-seed weight — except at Hissar, where 100-seed weight in the exposed pods (18.5 g) was significantly higher (at $P = 0.05$) than in the controls (17.6 g).

Combined analysis using the two cultivars (850-3/27 and L-550) common at all the three locations also did not reveal any significant difference (at $P =$

TABLE I

Effect of pod exposure on chickpea yields at Hyderabad, Hissar, and Dalang.

Treatment	Yield (kg/ha)			
	Hyderabad	Hissar	Dalang	Mean
Control	800	3317	820	1645
Pod exposed	789	3211	771	1590
L.S.D. (0.05)	N.S.	N.S.	N.S.	

0.05) in yield between exposed pods (1613 kg/ha) and control (1534 kg/ha). The mean treatment response was not significant but was converse to the one observed in Table I, as they are based on a different number of observations. Yields at Hyderabad (871 kg/ha) and Dalang (713 kg/ha) were similar but significantly lower (at $P = 0.05$) than the yields at Hissar (3136 kg/ha).

Our experiments were carried out in three very different environments: at a high altitude location in the summer, in the winter under very favorable conditions at Hissar, and under less favorable conditions at the ICRISAT Center. The consistently negative results indicate that the "exposed pod" character is unlikely to be of value in breeding for higher yield potentials.

Pod exposure may have had no effect on yield because pod photosynthesis was of relatively little importance and/or because light intensity was not limiting photosynthesis in the shaded pods. The higher radiation load on the exposed pods probably resulted in their heating up more than the shaded pods; it is possible that the increased 100-seed weight in the exposed pods at Hissar may have been owing to a higher pod temperature rather than to an effect on pods photosynthesis.

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