Effect of planting method on growth and seed yield of chickpea under rainfed conditions

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Abstract

In two years of field experiments chickpea (*Cicer arietinum* L.) cv. Nabin was planted by five different methods (broadcast in prepared bed, direct drilling, direct dibbling, dibbling with mulch and drilling with mulch) under rainfed conditions. Establishment was good for both years as emergence averaged 95%, but during 1990-91 drilling followed by mulch caused some seedling mortality due to excessive moisture. Except for direct drilling (1.90 t/ha) and direct dibbling (2.17 t/ha) seed yields were similar (2.21 - 2.50 t/ha) in 1990-91. However, the highest seed yield of 3.38 t/ha was obtained from drilling with mulch in 1991-92. In that season, this treatment significantly outyielded the broadcast, direct dibbling and direct drilling treatments, all of which had similar seed yields. The yield increase was mainly due to an increased number of pods/m^2 (a product of pods/plant and plants/m^2) as seeds per pod and 1000-seed weight did not differ significantly. Plants established by direct dibbling and drilling in 1990-91 and also broadcast in 1991-92 flowered and matured slightly earlier than either dibbling or drilling with mulch. Except for direct dibbling and broadcasting treatments the plants did not suffer from moisture shortages in either year.

Additional key words: *planting methods, chickpea, yield components, seed yield, growth, maturity time, rainfed conditions*

Introduction

In low rainfall areas of Bangladesh it is difficult to raise two or more crops in a year without supplemental irrigation. Winter crops in particular suffer most due to shortage of moisture at the end of the life cycle (Aujla and Cheema, 1985). However, as the winter (dry) season starts early (October) and finishes in late February in this elevated land area of Bangladesh, a crop like chickpea may be planted earlier than in other chickpea growing areas (where the season starts in November) to ensure good establishment (Khan and Chatterjee, 1987). As very little time is left to cultivate the land, due to the pre-occupation of farmers with other jobs like rice harvesting, and also because of the rapid moisture loss due to dry weather which occurs during cultivation, direct drilling or dibbling might be helpful for seedling establishment (Singh and Singh 1985; Giraldez *et al.*, 1986). Zero or minimum tillage sometimes gives an equivalent or greater seed yield than conventional tillage in chickpea (Giraldez *et al.*, 1986) and lentil (Singh *et al.*, 1989). As the crop can suffer from acute moisture deficiencies from the end of flowering to the pod-filling stages, straw mulch might be helpful to conserve stored soil moisture and to increase seed yield (Aujla and Cheema, 1985; Droughton *et al.*, 1993). The objective of the present experiment was to investigate the possibility of growing chickpea under rainfed condition after the main rice crop in a rice-based monocropping system, to conserve soil moisture, improve soil fertility and seed yield (Dalal *et al.*, 1991; Summerfield, 1986). Different planting methods were used to evaluate their relative merits for moisture retention, plant establishment, and seed yields of chickpea under rainfed conditions.

Materials and Methods

The experiment was conducted at the On Farm Research Division at Godagari, Rajshahi (24°N, 27°E) during 1990-91 and 1991-92. The soil was a silt loam of old Gangetic alluvium plain (Aeric Haplaquept) with pH 5.6. The previous crop was transplanted rice in puddled soil for both years under rainfed conditions. There were five planting methods of chickpea (*Cicer arietinum* L.) cv. Nabin ((i) broadcast in prepared bed (bed was prepared by ox-drawn country plough and laddering), (ii) direct drilling (seeds placed directly in farrow opened by country plough), (iii) direct dibbling (seeds placed in holes made with a peg), (iv) drilling with mulch (thick straw and water hyacinth) and (v) dibbling with mulch).

Treatments (ii) to (v) were in moist (wet) uncultivated soil just after the rice harvest. Harvesting of rice was on 22 October in 1990-91 and 26 October in 1991-92. The experiment was laid out in a randomised complete block design with four replications. The unit plot size was 4 m x 5 m with 0.75 m in between plots. Direct drilling and dibbling was done on 23 and 27 October and broadcasting on 31 October and 3 November for 1990-91 and 1991-92, respectively. Fertilisers were applied at 40, 60, 40 kg/ha of N, P_2O_5, K_2O in the form of urea, triple super phosphate and muriate of potash, respectively. For dibbling, a mixture of all fertilisers was applied in holes adjacent to the seed holes, but in the broadcast and direct drilling treatments, fertilisers were applied during seeding.

Soil moisture at 0-30 cm depths was monitored regularly until maturity. Soil samples were taken from each plot by a soil core, composited for the replications and weighed sub-samples were oven dried at 105°C to obtain the actual moisture content. Dry matter of 10 plants was recorded from each plot after drying for 48 h in a hot air oven at 70°C. Plant count/m^2 was made at 15 days after sowing, and at maturity. Yield component data were taken from 10 randomly selected plants, but seed and straw yields were taken from the whole plot leaving two border rows. Harvest index was calculated by dividing seed yield with total above ground dry matter at the same moisture level. Data were analysed statistically using GENSTAT.

Results and Discussion

In 1990/91, soil moisture content for different treatments was similar initially and moisture loss occurred up to 58 days after sowing (Table 1). Thirty mm rain fell at 65 days after sowing. During 1991-92 rain was early at 50 days after sowing and there was little visual evidence to moisture deficiency during the active growth stage, as the soil moisture always remained between field capacity and wilting point. Application of 5 cm thick straw + water hyachinth mulch initially conserved moisture to sustain normal plant growth and development in both seasons, a result comparable to that of Singh and Singh (1985) and Giraldez *et al.* (1986), but at crop maturity soil moisture was at permanent wilting point for all treatments.

Seed yield was highest with direct drilling with mulch for both years but did not significantly differ from that of broadcasting in 1990-91. The lowest seed yield was obtained from broadcasting during 1991-92 and from direct drilling during 1990-91 (Table 2). Dibbling with mulch produced a similar seed yield to that of direct drilling with mulch. Similar seed yield were also reported by Giraldez *et al.* (1986) for chickpea and Singh *et al.* (1989) for lentil for zero tillage and mulch application. Thus it appears that straw + water hyachinth mulch conserved more moisture, kept the soil cool to some extent and favoured seed yield in the present experiment. Straw yield followed a similar pattern to

Table 1. Effect of planting method on the gravimetric moisture retention (%) in the top 30 cm at different days after sowing under rainfed conditions.

Treatments	Days after sowing						
	18	31	58	78	97	120	135
1990-91							
Broadcast	22.4	20.1	19.6	21.1	20.8	19.8	17.5
Direct drilling	22.6	20.4	19.9	21.1	20.5	19.8	17.8
Direct dibbling	22.4	19.8	19.3	20.5	19.8	19.0	17.0
Dibbling+mulch	22.7	21.6	21.0	22.0	21.5	20.0	18.2
Drilling + mulch	23.6	22.8	21.8	23.0	22.0	20.7	18.8
1991-92							
Broadcast	24.3	21.4	22.0	21.7	21.4	18.2	17.0
Direct drilling	23.8	21.8	22.2	21.5	21.2	18.8	18.0
Direct dibbling	23.5	21.4	22.0	21.3	20.5	18.0	17.1
Dibbling+mulch	24.0	23.8	23.0	22.8	21.0	19.2	18.3
Drilling + mulch	24.3	23.7	23.5	23.0	22.0	20.0	18.5

Table 2. Effect of planting method on seed yield, yield components, dry weight, flowering and maturity time of chickpea under rainfed conditions.

Treatments	Yield (t/ha) seed	straw	Plant/m^2	Pods/ plant	Seed/pod	TSW (g)	Harvest index	Dry wt (g/plant)	Days to flowering[1]
1990-91									
Broadcast	2.40	2.80	21.8	64.3	1.35	135.5	0.47	13.8	75(138)
Direct drilling	1.90	2.19	21.0	58.0	1.38	132.5	0.47	13.2	74(135)
Direct dibbling	2.17	2.30	22.8	54.3	1.43	135.0	0.44	11.8	70(131)
Dibbling+mulch	2.21	2.45	22.3	68.8	1.25	130.5	0.47	12.8	72(139)
Drilling + mulch	2.50	3.00	18.3	88.3	1.38	127.5	0.46	15.0	76(139)
LSD (0.05)	0.285	0.650	1.81	6.67	NS	NS	0.03	1.19	1.7(1.4)
CV(%)	5.9	6.4	3.9	4.6	9.5	4.2	2.5	4.7	1.1(1.5)
1991-92									
Broadcast	2.81	3.11	20.8	70.3	1.45	136.5	0.47	15.0	73(136)
Direct drilling	2.92	3.22	22.0	70.0	1.48	134.5	0.48	15.2	75(138)
Direct dibbling	3.00	3.32	24.0	65.0	1.50	136.0	0.48	13.6	72(133)
Dibbling+mulch	3.14	3.49	23.8	69.3	1.45	135.5	0.47	15.4	77(140)
Drilling + mulch	3.38	3.68	24.3	74.3	1.48	133.8	0.49	15.8	77(142)
LSD (0.05)	0.235	0.360	1.71	6.17	NS	NS	NS	1.12	2.7(3.9)
CV(%)	6.9	6.8	4.1	6.6	8.5	6.4	2.8	4.9	2.0(2.5)

[1] Figures in paranthesis indicate total crop duration

seed yield in both years.

During 1990-91, direct drilling with mulch significantly reduced the number of plants/m^2 at maturity, although the initial number was similar for all the treatments. This was due to seedling mortality resulting from supra-optimal soil moisture conservation with semi-dry water hyachinth and straw mulch in the opened farrow during seedling emergence. However, during 1991-92 drilling with mulch retained a greater number of plants/m^2 than any other treatment (Table 2). The only significant increase in pods/plant was obtained from drilling with mulch during 1990-91. This could either be due to increased plant growth duration resulting from better moisture conservation with water hyachinth and straw mulch, or lower plant to plant competition resulting from seedling mortality. The result is consistent with those of Aujla and Cheema (1985) and Droughton *et al.* (1993). Seeds/pod and 1000-seed weight (TSW) were not significantly different in either year (Table 2). Harvest index was significantly lowest with direct dibbling during 1990-91 which could have been due to dry top soil in this treatment as it gradually lost more moisture than any other treatment (Table 1) from flower initiation to maturity stages which left the plants with fewer pods/plant. Harvest index was not significantly different during 1991-92. Dry matter/plant followed the pattern of seed and straw yield for both years (Table 2). Plants established by direct dibbling flowered and matured earlier than the other treatments in the first season but not the second. Direct drilling with mulch increased the crop duration slightly in 1991/92, which could have helped to increase seed yield in this treatment as compared to direct dibbling or drilling. Although direct dibbling or drilling tended to produce a lower seed yield, they did produce an average yield of 2.41 t/ha, which is well above the national average. Although mulching produced the greatest seed yield, straw or water hyachinth mulch is not readily available, and the process is labour intensive and might not be economically viable (Khan and Chatterjee, 1987).

Conclusions

All the planting methods allowed good plant growth and seed yield. Direct drilling or dibbling is feasible in chickpea production, adding an important additional crop to the rice-based cropping system in the elevated land area of Bangladesh and similar soils elsewhere. Application of mulch effectively conserved moisture and increased seed yield.

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