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Studies on effect of planting method and mulch on *summer* groundnut (*Arachis hypogaea* L.)

D. Dutta
Bidhan Chandra Krishi Viswavidyalaya, Regional Research Sub-station (Red & Laterite Zone), Sekhampur, BIRBHUM (W. B.) INDIA

ABSTRACT
A field experiment was conducted during summer (*pre-kharif*) seasons of 2003 and 2004 at Jhagram, West Bengal, on acid laterite soil to study the effect of various planting methods and mulches on growth, yield, nutrient uptake and water-use efficiency of groundnut variety 'ICGS 44' under irrigated conditions. Groundnut yield was not influenced significantly due to planting methods, viz. flat bed method and paired-row bed furrow method; however, higher pod yield was recorded with paired-row bed furrow method. Growth, yield and yield components of groundnut were increased significantly due to polythene film (7 micron) mulching, followed by rice straw mulching. The polythene mulched groundnut produced significantly higher pod yield (3097 kg/ha) over rice straw mulch, rice husk mulch and no mulch treatment. The uptake of NPK and water-use efficiency was also increased with paired-row bed furrow as well as polythene film mulching.

Key words : Groundnut, Planting method, Mulch, Growth, Yield, Nutrient uptake, Water-use efficiency

INTRODUCTION

In the contemporary agricultural situation, groundnut has the distinction of occupying an area of 8 m ha (34.4 %) and contributes 8 m t (26.6 %) to the world's area and production and ranks first in the world. Paradoxically, the average productivity of this crop is one of the lowest (1000 kg/ha) as compared to the Republic of China (2710 kg/ ha), World (1244 kg/ha) and Asia (1417 kg/ha) and subject to wide fluctuations. The phenomenal improvement in Chinese groundnut productivity has been attributed to large-scale cultivation of medium bold seeded varieties as well as extensive use of polythene film for mulching under improved cultural practice (Hu *et al*., 1995). Various materials like straw, hay, trashes, dry leaves etc. have been used for long back as natural mulch to conserve soil moisture, arrest weed growth and improve soil physical properties. However, in India, use of plastic film as mulch in agricultural field is still at a conceptual stage. Groundnut is generally grown in flat bed (a conventional method) whereas the paired-row bed furrow method of planting is a recent technology developed by ICRISAT. Capitalizing the polythene film mulch technology for revolutionizing groundnut yield in China, the present investigation was undertaken to evaluate the impact of organic and plastic mulching on summer groundnut under conventional and new method of planting.

MATERIALS AND METHODS

A field experiment was conducted during summer (*pre-kharif*) seasons of 2003 and 2004 at Jhargram Adaptive Research Farm (Paschim Midnapore), West Bengal. The soil of the experimental site was acid lateritic (Alfisols-Haplustalf), sandy-clay loam in texture with pH 5.6, organic carbon 0.38 %, available N 189.17 kg/ha, available P 11.53 kg/ha and available K 200.16 kg/ha. The experiment was laid out in split plot design, keeping planting methods (flat bed and paired-row bed furrow) in main plots and mulches (no mulch, rice husk mulch, rice straw mulch and polythene mulch)in sub plots. Transparent polythene films of 7 micron thickness was used for mulching. The groundnut variety 'ICGS 44' was sown in the first week of February in both the years. Farm yard manure @ 10 t/ha and the recommended does of fertilizers (30 kg N, 60 kg P_2O_5, 40 kg K_2O and 400 kg gypsum /ha) were applied as basal in all plots. Fluchloralin, a pre planting herbicide @ 1.25 kg a.i./ha, was sprayed on bed surface. Subsequent recommended practices were kept the same for all the treatments.

In flat bed planting, seeds were sown at a spacing of 30 cm x 10 cm in both mulched and non mulched plots. In paired-row bed furrow method, the beds were formed at a width of 60 cm leaving 15 cm on the either side for the furrows and sowing was done at a spacing of 30 cm x 6.65 cm in each bed. Rice husk @ 10 t/ha and rice straw @ 4 t/ha were applied as mulch after establishment of seedlings in the field, whereas polythene mulch was sprayed before sowing. Before spreading the polythene films, holes were made in the films at the required spacing. Pre-sowing irrigation, followed by irrigation at branching, flowering, pod initiation and pod development stage was given to the crop. Growth parameters, yield components and yield were recorded at harvest. N, P and K contents in the crop (plant and pod) were determined by standard methods and the nutrient uptake was calculated. Consumptive use (CU) was determined by soil moisture depletion method and water-use efficiency was computed.

RESULTS AND DISCUSSION

Growth parameters

The growth parameters, namely height of the plant, number of branches, dry matter production and number of root nodules per plant were not influenced significantly due to planting methods (Table 1). However, the plant height (35.5 cm), number of branches (5.9), dry matter production (15.05 g) and number of root nodules (39.0) per plant were recorded higher in paired-row bed furrow method as compared to flat bed method.

Growth parameters were varied significantly among the different mulching treatments (Table 1). The maximum and significantly higher plant height (38.3 cm), number of branches (6.5), dry matter production (16.38 g) and number of root nodules (46.1) per plant were recorded under polythene mulched groundnut over other mulches, followed by rice straw mulched groundnut. However rice straw mulching in groundnut did not show any significant variation with rice husk mulched groundnut in respect of growth parameters. Tiwari *et al*. (1991) also reported similar observation in chickpea. Application of polythene mulch in groundnut produced 51 and 13 % more dry matter per plant than non-mulched and rice straw mulched groundnut respectively, which in turn reflected in producing taller plant and more branches per plant under this treatment. Higher root nodulation as observed under polythene mulch treatment might help in assimilate more atmospheric nitrogen resulting in greater accumulation of dry matter in plant. Significant increase in growth parameters due to application of polythene mulch in groundnut corroborates the results of AICRP on Dry Land Agriculture (2000-2001).

Yield and yield components

Planting methods showed no significant variation in pod yield of groundnut (Table 2). An increase of 92 kg/ha in pod yield was observed due to paired-row bed furrow method over flat bed method. These findings are in agreement with Shelk *et al*. (1997).

Table 1 : Effect of planting method and mulch on growth parameters of groundnut (pooled data of 2003 and 2004)

Treatment	Plant height (cm)	Number of branches/plant	Dry matter production (g/plant)	Number of root nodules/plant
Planting method				
Flat bed	34.3	5.5	12.97	35.5
Paired-row bed furrow	35.5	5.9	15.05	39.0
LSD (P = 0.05)	*NS	NS	NS	NS
Mulch				
Non mulch	30.3	4.7	10.81	30.0
Rice husk mulch @ 10 t/ha	35.0	5.6	14.44	34.6
Rice straw mulch @ 4 t/ha	36.1	6.0	14.41	38.3
Polythene mulch 7 micron	38.2	6.5	16.38	46.1
LSD (P = 0.05)	4.16	0.77	1.45	5.63
Interaction	NS	NS	NS	NS
CV %	8.32	9.80	7.51	10.96

*Not significant

The different mulching treatments significantly influenced the pod yield (Table 2). However, the rice straw mulched and rice husk mulched treatments were statistically at par to each other in respect of pod yield. Polythene mulched groundnut recorded maximum and significantly higher pod yield (3097 kg/ha), an increase by 18 % followed by rice straw mulching and that of 28 and 57 % over rice husk mulching and no mulching in groundnut respectively. Higher pod yield under polythene mulched groundnut than straw mulched and non mulched groundnut was reported by Buung and Kyu (1997). Application of rice straw mulch increased pod yield by 8.9 and 33 % over rice husk and non mulched groundnut respectively. Ghorai *et al*. (1994) had also obtained similar type of results.

The yield components, namely number of pods/plant, shelling (%) and 100-kernel weight showed a similar trend of variation as that of pod yield of the crop under different planting methods and mulches (Table 2). Higher yield components as obtained under paired-row bed furrow method compared to flat bed corroborate the findings of Kathmale *et al*.(2000). Number of pods/plant, shelling (%) and 100-kernel weight were 22.39, 5.58 and 12.61 % higher under polythene mulched groundnut than straw mulched groundnut and that of 28.14, 10.96 and 9.48 % higher than rice husk mulched and 70.49, 14.12, and 25.99 % higher over non mulched groundnut. Buung and Kyu (1997) reported 2.4 to 4 % higher shelling (%) and kernel weight under polythene mulched groundnut. Rice husk mulched groundnut significantly increased the yield attributes and yield of groundnut than non mulched groundnut, however, this treatment was statistically at par with rice straw mulching.

The interaction effects between planting methods and mulching were not significant.

Nutrient uptake

Planting methods did not influence significantly the uptake of nutrients (NPK) by the crop, but an increasing trend in uptake was recorded with paired-row bed furrow method as compared to flat bed method of planting (Table 3).

A significant variation in uptake of nutrients was recorded with mulch treatments. The increase in uptake of nutrients in mulched groundnut over non mulched groundnut was mainly due to increase availability in soil moisture which plays an important role in the mechanism of nutrient uptake involving diffusion, mass flow and interception (Tisdale *et al*., 1985). Maximum and significantly higher uptake of nutrients under polythene mulched groundnut might have resulted from higher availability of soil N, P, K. This might be attributed to the increase of soil temperature resulting in higher microbial activity, greater decomposition of organic matter present in the soil in the first phase and then due to decomposition of perished microbes when soil temperature increased beyond the critical limit (Nanjappa and Ramachandrappa, 2000).

Soil moisture depletion and water-use efficiency

Results showed that there was a marginal variation in soil moisture depletion and water-use efficiency due to different planting methods (Table 3). However, soil moisture depletion and water- use efficiency were influenced by different mulching treatments. Consumptive use by the crop was highest under no mulch condition due to more depletion of soil moisture owing to increased evapotranspirational loss after each irrigation, but maximum water-use efficiency was recorded with polythene mulched groundnut, followed by rice straw mulching. Application of polythene mulch or rice straw mulch decreased the

Table 2 : Effect of planting method and mulch on yield and yield components of groundnut (pooled data of 2003 and 2004)

Treatment	Number of pods/plant	Shelling (%)	100-kernel weight (g)	Pod yield (kg/ha)
Planting method				
Flat bed	15.78	64.15	36.92	2476
Paired-row bed furrow	16.33	62.61	38.18	2568
LSD (P = 0.05)	NS	NS	NS	NS
Mulch				
Non mulch	11.83	58.73	33.16	1965
Rice husk mulch @ 10 t/ha	15.74	61.63	38.16	2406
Rice straw mulch @ 4 t/ha	16.48	64.77	37.10	2620
Polythene mulch 7 micron	20.17	68.39	41.78	3097
LSD (P = 0.05)	1.43	3.43	2.98	276
Interaction	NS	NS	NS	NS
CV %	6.46	3.93	5.77	8.62

Table 3 : Effect of planting method and mulch on nutrient uptake, soil moisture depletion and water-use efficiency groundnut (pooled data of 2003 and 2004)

Treatment	Nutrient uptake (kg/ha) N	P	K	Soil moisture depletion (cm)	CU (cm)	Water-use efficiency (kg/ha-cm)
Planting method						
Flat bed	114.11	10.81	37.27	50.2	62.36	39.70
Paired-row bed furrow	116.39	11.61	41.15	49.0	61.14	42.00
LSD (P = 0.05)	NS	NS	NS			
Mulch						
Non mulch	106.11	9.35	30.13	54.7	66.85	29.39
Rice husk mulch @ 10 t/ha	114.82	11.04	40.82	49.4	61.54	39.09
Rice straw mulch @ 4 t/ha	116.79	11.51	40.79	48.1	60.25	43.48
Polythene mulch 7 micron	123.28	12.94	45.10	46.2	58.36	53.06
LSD (P = 0.05)	123.29	6.41	1.32			
	4.13					
Interaction	NS	NS	NS			
CV %	4.03	8.54	7.64			

depletion of soil moisture due to less evaporation, resulting in better availability of moisture which in turn increased the availability of plant nutrients in soil and their uptake by plant led to produce increased yield of the crop. The results are in the line with Nayak (1998).

Hence, the study suggests that the yield of summer groundnut may be augmented by providing polythene film mulch under either paired-row bed furrow or flat bed planting method for hot and humid climate of laterite West Bengal.

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