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Sowing time and seedbed modification for yield maximization in groundnut in north Konkan

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ABSTRACT

Field experiment conducted with four sowing dates (48th, 50th, and 02nd Met. Week), two groundunt (*Arachis hypogaea* L. Sub sp. *Fastigiata* var. *Vulgaris*) varieties (Konkan gaurav and Phule pragati) and three sowing methods (flat bed, broad bed furrows (BBF) and BBF + polymulch) in split plot design at the ASPEE Agriculture Research and Development Farm at Met (Thane district) on medium black soil during *rabi* 1998-99 revealed that the delayed sowing led to 4 to 9% loss in dry matter per plant compared to early sown crop (48th Met. Week). There was heavy decline in pod number per plant (6 - 27.5%), pod yield (11-36%) and haulm yield (3-36%). However, the harvest index remained unaltered. Polymulching (7 μ thick) groundunt crop on broad bed increased soil temperature by 3-4 °C and resulted in increased pod yield, despite 20 per cent less population. Harvest index and oil content were also improved due to polymulching. Accumulated heat units during vegetative phase reflected 80 per cent variation in pod yield of groundnut. The total heat unit requirement (1600 to 2000 GDD) of groundnut was distributed largely as 25 and 7 per cent, respectively during vegetative and reproductive phases.

Key words : Time of sowing, Polymulching, Heat units, Broad bed furrow, Flat bed

Groundnut (*Arachis hypogaea* L. Sub sp. *Fastigiata var. Vulgaris*) crop can be grown in wide range of climatic conditions. Warm nights (Beil *et al.*, 1992) and high temperature (36-43 °C) during flowering and pod development favour yield increase. The crop has been recently introduced in Konkan region of Maharashtra and has been found to be a promising oilseed both in north and south Konkan zones on medium black and lateritic soils (Patil, 1989). Genotype and the optimum sowing time are the primary inputs (Ghadekar, 1993) for better yields. Method of planting in groundunt has an important bearing on maximizing productivity appreciably (Amin *et al.*, 1987). Groundnut crop sown early in *rabi* season (November-December) as irrigated crop in Konkan is subjected to low winter temperature, enough

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to dealy germination, reduced growth and low pod yield. Plastic film mulch has been found to increase soil temperature by 2-3 ^{0}C (Tang and Xu, 1986). In view of above, an investigation was carried out on two groundnut varieties to evaluate the influence of different sowing times, mulch application and methods of sowing.

MATERIALS AND METHODS

A field experiment was conducted at the ASPEE Agricultural Research and Development Foundation (Tansa Farm), Met in Thane district of Maharashtra in split plot design with three replications during *rabi*, 1998-99. The main plot treatments comprised four dates of sowing (48th, 50th, 52nd and 02nd Met. week) and two varieties (Konkan gaurav and Phule pragati). The sub-plot treatments comprised three methods of sowing (flat bed, broad bed furrow (BBF) and BBF with polymulch of 7 μ thickness). The soil of the experimental plot was clay with 0.92 per cent organic carbon, 348, 39 and 360 kg ha^{-1} available N, P_2O_5 and K_20, respectively and pH 7.1.The gross plot size was 3.6 x 3.0 m^2 and net plot size was 3 x 2 m^2. A basal fertilizer dose of 25 kg. N, 50 kg P_2O_5 and 50 kgK_2O was applied by placement below seed rows at the time of sowing. In case of polythene mulch treatment, 50 cm wide beds with 11-12 cm height were prepared after preparation of land to fine tilth. Herbicide, Butachlor was sprayed on the surface of the beds after irrigating the bed. The polythene film having 7 micron thickness (90 cm wide) was laid on the beds and the edges were burried on either side of the bed to hold the film in place. The seed holes (2.5 cm diameter) 3-4 cm deep, were made by puncturing the film at 30 x 15 cm distance. Two Thirum treated seeds (4 g kg^{-1}) were sown in each hole and covered with moist soil. There were four rows on each bed. The broad bed furrows were of 1.2m top width and 15 cm height. There were four rows on each bed at 30 x 15 cm spacing. The plant population on broad bed with furrow (BBF) and BBF + polymulch was 1,77,778 hills per hectare compared to 2,22,222 hills per hectare in conventional flat bed planting which was 20 per cent less in comparison with the former method. No earthing up was given for BBF treatment. All the other cultivation practices were followed as per recommendations. At harvest, observation on growth, yield contributory characters and pod yield of groundnut were recorded and analysed for drawing inferences. Soil temperature (0-20 cm at 30,60,90 DAS and at harvest) was recorded in different treatments. Economics of the treatments and crop-weather relationships were also studied.

RESULTS AND DISCUSSION

Effect of time of sowing

Variation in time of sowing (from 48th to 02nd Met. week) led to significant variation in all the growth and yield parameters and pod yield of groundnut (Table1 -1). Early sowing in 48th Met. week resulted in taller plants (36.34 cm) with improved dry matter per plant (64.21 g). The

Table 1 : Yield and yield contributing characters, quality,economics of groundnut and soil temperature variation due to treatments

Treatment	No.of pods/ plant	100 kernel weight (g)	Dry pod yield Kg ha^{-1}	Dry matter (g)	Harvest index	Oil content (%)	Shelling percentage	Gross returns Rs. ha^{-1}	Net return Rs. ha^{-1}	Soil temperature* °C		
										30	60	90#
Time of sowing												
48th Met. week (26th Nov.to 02nd Dec.)	30.84	58.43	3518	64.21 (36.34)	31.17	47.99	72.87	58.590.00 (31565.63)	27024.37 (1.85)			
50th Met.week (10th to 16th Dec.)	28.85	57.29	3117	61.37 (33.89)	30.82	48.77	69.71	52.386.00 (30775.47)	21611.00 (1.70)			
52nd Met.week (24th to 31st Dec.)	26.92	55.72	2726	58.27 (32.67)	30.02	47.56	70.27	45221.25 (28337.50)	15883.75 (1.54)			
2nd Met. week (8th to 14th Jan)	22.35	54.91	2759	28.27 (30.97)	31.54	46.45	68.43	35557.00 (27726.79)	7830.21 (1.28)			
F test	Sig.	Sig.	Sig.	Sig.	N.S.	Sig.	N.S.					
S.E. ±	0.528	0.380	103	0.729 (0.566)	0.612	0.409	1.423					
C.D. @ 5%	1.600	1.152	311	2.211 (1.698)		1.241						
Varieties												
Konkan gaurav	26.43	62.87	2769	59.98 (35.19)	30.53	47.36	69.43	46409.25 (29535.50)	16873.75 (1.57)			
Phule pragati	28.04	50.31	3042	59.78 (31.75)	31.19	48.09	71.16	50483.25 (30214.50)	20268.75 (1.67)			
F test	Sig.	Sig.	Sig.	N.S. (Sig)	N.S.	N.S.	N.S.					
S.E. ±	0.373	0.268	73	0.516 (0.396)	0.433	0.289	1.007					
C.D. @ 5%	1.132	0.814	220	(1.201)								
Method of sowing												
Flat bed	19.71	51.85	1608	57.82 (32.18)	29.64	45.87	68.07	30374.25 (26373.41)	4000.77 (1.15)	15	26	30
Broad bed furrow BBF with polymulch	36.64	62.64	3857	63.34 (35.26)	31.48	49.80	74.34	64182.00 (3.4279.93)	29902 07 (1.87)	15 19	26 29	30 34
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.					
S.E. ±	0.763	0.548	87	0.648 (0.38)	0.297	0.339	1.271					
C.D. @ 5%	2.113	1.517	241	1.794 (1.71)	0.711	0.939	3.52					

Figures in bracket indicate height (cm) in column 5, cost of cultivation (Rs.)in column 9 and B.C.ratio in column 10
Selling rate of pods Rs.15 kg^{-1} and haulm Rs.0.75 kg^{-1} * depth 0-20 cm.# Days after sowing

Table 2 : Interaction effect on time and method of sowing on groundnut pod yield (kg ha^{-1})

Time of sowing	Method of sowing		
	Flat bed	BBF	BBF with polymulch
48th Met. week	2247	3398	4909
50th Met. week	1953	3091	4308
52th Met. week	1554	3193	3433
02nd Met. week	1477	2521	2786
S.E. .±	174		
C.D.	502		

Table 3 : Heat unit distribution and heat use efficiency in groundnut

Time of sowing	Heat unit (G.D.D.) (°C)		Total heat unit	Heat use efficiency polymulch
	Veg. Phase	Rep. Phase		
48th Met. week	45 (26)	1312 (74)	1763	1.99
50th Met. week	475 (29.6)	1131 (70)	1606	1.94
52nd Met. week	468 (24.6)	1432 (75)	1900	1.43
02nd Met. week	507.25 (25)	1503 (75)	2011	1.12

plant height declined from 33.9 to 30.9 cm and dry matter per plant from 61.3 to 58.22 g with delayed sowing from 50th Met. week to 02nd Met. week indicating 6.7 to 14.9 per cent and 4.5 to 9.3 per cent reduction in height and dry matter per plant respectively. These observations suggest that plant height is more sensitive to growing environment than the dry matter. The yield contributing characters and pod yield of groundnut showed marked positive influence of early growing environment (of 48th Met. week) compared to delayed sowing. Delay in sowing led to heavy reduction in pod number per plant (6.42 to 27.5), pod yield (11.42 to 35.8%) and haulm yield (3.3. to

36%), whereas kernel yield decreased moderately (1.9 to 6%), indicating thereby that haulm and pod yield are more sensitive than kernel yield to change in sowing time. Eventhough, the early sown crop put forth heavy vegetative growth, the harvest index due to varied growing environments remained unaltered thereby revealing the stablility of this parameter over growing enviornments.

The oil content of groundnut showed measurable reduction (4.7%) when sown after 52nd Met. week but shelling recovery remained unaltered suggesting greater sensitivity of oil content than shelling recovery in groundnut to variation in sowing time. Benefits of early sowing on growth, yield and quality parameters in *rabi* groundnut have been well documented by Ghadekar *et. al.*, (1993) at Nagpur in Maharashtra and Deka *et al.* (1997) in Assam. Economics in terms of net return (Rs. 27,024) and benefit cost (1.85) ratio showed substantial improvement due to early sowing in 48th Met. week, both of which heavily declined with subsequent delay in sowing from 50th to 02nd Met. week.

Of the two test varieties, Phule pragati was superior (Table 1) in pod number per plant and pod yield per hectare compared to Konkan gaurav whereas Konkan gaurav was superior to Phule pragati in plant height and 100 kernel weight. In all the other parameters the two varieties were at par. The economic benefit was also in favour of Phule pragati having Rs.20,268 net return ha^{-1} and 1.67 Benifit Cost ratio indicating overall superiority of this variety over Konkan gaurav (Patil *et al.* 1980).

Polymulch

Application of polymulch improved growth, yield and quality parameters of groundnut (Table 1). The plant height and dry matter showed significant improvement (9.5%) under polymulch on broad bed over the flat bed method. These observations suggest that yield could be substantially modified by changing sowing method in groundnut. The oil content of kernel also increased markedly by broad bed and further raised by polymulching on broad bed, whereas shelling turnout was improved by polymulching alone. Yield improvement due to polymulching may partly be attributed to maintenance of 3-5°C higher soil temperature (Table 1) at different crop growth stages compared to flat bed and broad bed without mulch (Tang and Xu, 1986).

Interaction effect

Early sowing in 48th Met. week in conjunction with broad bed furrow and polymulching (Table 2) maximized groundnut productivity (4909 kg ha^{-1}) appreciably. The effect of polymulch was consistent up to 50th Met. week. The early sown crop was subjected to long low temperature period (December to February) but as polymulch maintained 3-4°C higher soil temperature particularly during vegetative phase; it resulted in early germination, faster growth and early maturity (10-15 days) of the crop. These results corroborate findings of Wang Cabin *et al.* (1992). Broad bed and furrow method was also next best for yield maximization owing to its influence on better air moisture relationship in medium black soil (Patil, 1989).

Heat units and yield

Crop-weather relationships also indicated that heat units accumulated during vegetative phase contributed 80 per cent variation in pod yield of groundnut. The best regression fit for yield prediction in groundnut based on accumulated heat units during vegetative phase was as follows.

$Y = 126.12\text{-}0.2042$ H.U. (Veg. Phase), $R^2 = 0.81$

Where Y= Groundnut Yield.

The heat unit requirement of the crop ranged between 450 and 507 degree days and between 1131 and 1503 degree days during vegetative phase and reproductive phase, constituting 25 to 29 per cent and 70 to 75 per cent of the total degree days, respectively (Table 3). The heat use efficiency was maximum (1.94 to 1.99 kg $^0C^{-1}$) when the sowing of groundnut was completed from 48th to 50th Met. week (between 26th November and 16th December)

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