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Short Communication

Effect of sowing date and row geometry on visible albedo of gram *(Cicer arietinum* L.*)*

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Gram *(Cicer arietinum* L.*)* is an important pulse crop world over. In India, gram occupies a premier position both in area (6.76 M ha) and production(5.56 Mt.). In Maharashtra, it is grown in *rabi* (winter) season, utilizing conserved soil moisture, on a total area of 0.76 Mha with a production of 0.56 Mt and productivity of 730 kgha^{-1}. Obviously, productivity is very low and research is needed to improve its productivity.

Radiation plays an important role in plant growth. The biochemical processes leading to growth of plant and chlorophyll formation are intimately connected with the amount of radiation received. The variation in sowing dates changes the radiation receipt by the crop canopy and row geometry changes its spectral reflection characterstics. The albedo of crop canopy is a function of composition, morphology and its internal structure.

The present experiment was conducted to study the effect of sowing date and row geometry on visible albedo of gram during *rabi* season of 1995-96. It was laid out in factorial randomized block design with four replications. Three sowing dates and two crop geometries with spacings of 30.0x10.0 cm(S_1) and 22.5x10.0 cm(S_2) were used at the farm of Centre of Advanced Studies in Agricultural Meteorology, College of Agriculture, Pune. The seed of gram variety ' Vijay ' was dibbled on 11th November(D_1), 26th November (D_2) and on 11th December (D_3), 1995.

The spectral reflectance of canopy was measured by remote cosine receptor (LI-1800-10) inverted over the canopy, connected to the spectroradiometer (LI-1800) through a quartz fibre optic probe. The reflectance ratios were computed by the internal microcomputer of spectroradiometer. The albedo of photosynthetically active radiation (PAR; 400-700 nm) in the visible range was measured for each treatment, in four replications, on the same day, at phenological stages, which were attained in each treatment on a different day. Measurements were made at different hights above the crop canopy in each treatment and it was observed that a height, double the row spacing was appropriate because, consine receptor viewed the crop as a homogeneous canopy at that hight. Accordingly, the measurements were made at all the growth stages, viz., flowering

Table 1 : Effect of sowing dates and row spacing on diurnal pattern of visible albedo in Gram.

Treatments	Visible albedo at 12.30 hour of the day (%)								
	8.30	9.30	10.30	11.30	12.30	1.30	2.30	3.30	4.30
Sowing Date									
11th Nov.	5.66	4.63	4.34	3.85	3.57	3.83	4.24	4.61	4.90
26th Nov.	5.95	5.46	4.56	3.94	3.73	3.89	4.30	4.70	4.99
11th Dec.	5.90	5.36	4.48	3.91	3.67	3.80	4.31	4.54	4.90
SE ±	0.02	0.04	0.04	0.03	0.03	0.03	0.02	0.03	0.04
C.D.at 5%	0.07	0.11	0.12	N.S.	0.11	N.S.	N.S.	0.10	N.S.
Spacing									
30.0x10.0 cm	6.00	4.63	4.64	3.98	3.76	3.94	4.24	4.77	5.02
22.5x10.0 cm	5.67	5.01	4.28	3.81	3.55	3.74	4.16	4.46	4.83
SE ±	0.02	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.03
C.D.at 5%	0.06	0.09	0.10	0.07	0.09	0.07	0.06	0.08	0.10
Interaction									
SE ±	0.03	0.60	0.60	0.04	0.05	0.04	0.04	0.05	0.06
C.D.at 5%	0.11	N.S.	N.S.	N.S.	N.S.	N.S.	. N.S.	N.S.	N.S.
General Mean	5.84	5.15	4.46	3.90	3.65	3.84	4.28	4.62	4.93

Table 2 : Effect of sowing dates and row on visible albedo in gram.

Treatments	Visible albedo (%)		
	GS_1	GS_2	GS_3
Sowing Date			
11th Nov.	3.15	3.43	4.10
26th Nov.	3.14	3.58	4.20
11th Dec.	3.23	3.59	4.25
SE ±	0.07	0.04	0.05
C.D.at 5%	N.S.	0.10	N.S.
Spacing			
30.0x10.0 cm	3.28	3.59	4.12
22.5x10.0 cm	3.06	3.48	4.25
SE ±	0.06	0.03	0.03
C.D.at 5%	0.16	0.10	0.10
Interaction			
SE ±	0.10	0.05	0.06
C.D.at 5%	N.S.	0.10	N.S.
General Mean	3.17	3.53	4.18

(GS_1), pod initiation (GS_2) and maturity (GS_3). Similarly, all measurements were made on clear days at solar noon when the angle of elevation of the sun was maximum. The visible albedo increased with increase in solar elevation (Table 1.)

As the solar elevation increases, the visible albedo decreases reaching to it's minimum at solar noon because the radiation is normally incident on the crop surface and penetrates deep into canopy (Suits, 1972). Significant differences in visible albedo were observed under different sowing dates at 8.30, 9.30, and 10.30 a.m., 12.30 noon and 3.30 p.m. The second sowing date (26^{th} Nov.) recorded significantly the highest albedo at 8.30, 9.30, 10.30, 11.30 a.m., 12.30 noon and 3.30 p.m. At 3.30 p.m. it was at par with the first sowing date (11^{th} Nov.) which itself was at par with the third sowing. This indicated that leaf area was better developed in second sowing as compared to first and third sowing at pod initiation.

The closer row spacing (22.5 x 10.0 cm) gave significantly lower visible albedo than normal row spacing (30.0 x 10 cm) at all the times of the day except at 9.30 a.m. This was due to higher vegetation cover in closer row spacing as also reported by Allen and Brown (1965), Fritchen, (1967), Ramakrishna Rao and Varade (1980), Rajhans *et al.*,(1995). Interaction between sowing date and row spacing were significant only at 8.30 a.m. in morning hours and non-significant thereafter.

Visible albedo increased from flowering (GS_1,3.17%) to maturity (GS_3,4.18%), indicating that it has an increasing trend from flowering to maturity (Table 2).Significant differences, amongst sowing dates, were found at GS_2 only of crop growth. Significantly the lowest albedo was recorded in first sowing (11^{th} Nov.) while, second (26^{th} Nov.) and third sowing (11^{th} Dec.) were at par with each other. This was due to more leaf area at pod initiation stage (GS_2) and more reflectance in green wavelength. The first sowing with profound growth in leaf area resulted in the highest yield(4271 $kgha^{-1}$). Between the geometry, both the row spacing was at par with each other at GS_2 growth stage. But, closer row spacing (22.5 x10 cm) had significantly lower albedo than normal row spacing (30.0 x 10 cm) at GS_1 and significantly higher albedo at maturity (GS_3). Interactions between sowing dates and row spacings were significant at GS_2 stage only.

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