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Studies on Growth Analysis and Yield of Redgram Varieties in *Rabi*

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ABSTRACT

A field experiment was conducted during *rabi* 2009-2010 to study the growth analysis and yield of red gram varieties in *rabi*. The results revealed that among early maturing varieties tested, Piler local recorded highest LAI (0.859), LAD (13.34 cm^2 day^{-1}), RGR (0.043g $g^{-1}day^{-1}$), NAR (1.33 mg dm^{-2} day^{-1}), SLA (138 Cm^2g^{-1}), SCMR (51.9) and yield (1672 kg / ha) compared to other varieties at 90 DAS. Among late duration varieties, LRG 41 recorded highest leaf area index (0.938), leaf area duration (13.82 cm^2 day^{-1}), NAR (1.08 mg dm^{-2} day^{-1}). SCMR (55.6) and seed yield (1862 kg/ha) compared to other varieties.

Key words : Growth analysis, Harvest index, Leaf area index, Net assimilation rate,Seed yield, SCMR.

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In Andhra Pradesh, redgram is grown in 4.62 lakh hacters with 3.01 lakh tons of production with a productivity of 652 kg ha^{-1} (India stat, 2008). It is mostly grown as *kharif* crop in Andhra Pradesh. *rabi* pigeon pea could be successfully introduced in the areas where winter temperatures are mild. Cultivation of red gram during *rabi* in Andhra Pradesh is meager. But due to frequent failure of *kharif* crops due to erratic south west monsoon is causing threat to socio economic condition of rain fed farmers. Though there are several crops recommended to be grown in *rabi*, redgram is most preferred when *kharif* crop is not sown or failed completely. Lakshminarayana (2003) reported that frequent failure of south west monsoon in Andhra Pradesh causes decreased yield of redgram when sown in *kharif.* There is need to develop production technology for *rabi* redgram cultivation. Hence exploring varieties suitable for sowing in *rabi* is highly essential.

Research results on cultivation of redgram in *kharif* were extensively reported. However similar work on *rabi* cultivation is less attempted. Though there are reports on production technologies, but work on physiological behavior of plant growth and growth analysis of existing varieties for *rabi* cultivation is scanty. Net assimilation rate is an index of photo synthetic efficiency which shows strong positive association with photo synthetic rate and grain yield. A significant positive correlation was obtained between LAD during post flowering and yield which was earlier reported by Nijhwan and Chandra (1980). Hence a detailed study was taken up to know the growth analysis and yield of redgram varieties during *rabi*

MATERIAL AND METHODS

A field experiment was conducted at wet land farm of S.V. Agricultural College, Tirupati during *rabi* season 2009-2010. The experiment was laid out in sandy clay loam soils in a randomized block design with ten varieties and replicated thrice. Treatments consists of ten varieties of red gram obtained from RARS, Tirupati (Early maturing varieties group (6); ICPL 85063, ICPL 87119, LRG 30, Piler local, TRG 21, TRG 7; late maturing varieties (4): ICPL 8863, PRG 148, LRG 41, TRG 22). The plot size was 6.0 mt x 5.0 mts. The crop was sown on 12th October 2009 with a spacing of 75 cm x 10 cm. Need based life irrigation were given. The crop was grown following the recommended package of practices and timely plant protection measures were also adopted. Sampling was done at 30 days interval. The leaf area was measured by LICOR 3000 leaf area meter and LAI was computed on the basis of leaf area per unit ground area. Destructive growth analysis of plant samples was done at 30 days time of interval till harvest and dried in oven at 80^{oC} for 48 hour. The other growth parameters were computed from leaf area and dry matter. The data on seed yield and yield components were recorded at the time of harvesting. The statistical analysis was done following Panse and Sukhateme (1985)

RESULTS AND DISCUSSION

Significant differences were observed among the varieties for leaf area index throughout the crop growth. (Table 1). The leaf area index increased upto 120 DAS in ICPL 85063, ICPL 87119, LRG 30, Piler local, TRG 21 and TRG 7 and later it was decreased. Where as late maturing varieties (ICPL 8863, PRG 148, LRG 41 and TRG 22) leaf area index increased upto 150 DAS and later decreased. Similar findings were reported by Puste and Jana (1990). The decline in leaf area index during harvest may be due to leaf senescence. Among the early duration varieties tested, Piler local recorded highest leaf area index at harvest, where as in case of late duration varieties LRG 41 recorded highest leaf area index at harvest. The highest LAI might be due to more leaf area and good growth thereby leaf area index. Similar results were reported by Rao and Singh (1997) in soybean and Rao (2004) in redgram.

Leaf area duration gradually increased from 105 to 120 DAS, later it was decreased at harvest incase of early duration varieties , where as in case of long duration varieties it was increased upto 150 DAS and then it decreased.(Table.1) There was a significant difference between the varieties for leaf area duration at all stages of crop growth.. Among the early duration varieties tested, Piler local recorded highest leaf area duration of 11.16 cm^2 day^{-1} and in late duration varieties, LRG 41 (11.32 cm^2 day^{-1}) recorded highest leaf area duration. Higher LAD during pod filling stage may be the reason for higher photosynthetic activity in piler local and LRG 41 which helped to accumulate and transport more assimilates into seed and resulted in higher seed yield. A significant positive correlation was obtained between LAD during post flowering and yield which was earlier reported by Nijhwan and Chandra (1980).

Crop growth rate is the product of leaf area index and net assimilation rate. The crop growth rate increased continuously upto 105-120 DAS and later there was a decreased up to harvest in all the varieties (Table 1). These changes in CGR and LAI corresponds to changes in their associated characters viz, number of leaves, and dry matter production. Among the early maturing varieties, LRG 30 recorded highest CGR of 5.79 g $m^{-2}day^{-1}$ and in case of late duration varieties LRG 41 recorded highest CGR at harvest. The highest CGR might be due to higher production of dry matter and leaf area. Such differences among the varieties were reported by Rahangdale *et al* (1994) in chick pea and Patra *et al* (1998) in ground nut.

Relative growth rate continuously increased upto 45-60 DAS and decreased later. There was a significant difference among the varieties for RGR throughout the crop growth (Table 2). The highest RGR (0.083 g g^{-1} day^{-1}) was recorded between 45-60 DAS. Among early duration varieties, LRG 30 and ICPL 85063 recorded highest RGR of 0.010 g g^{-1} day^{-1}. Among the late duration varieties there was no significant difference among the varieties for RGR at harvest. Relatively higher magnitude of relative growth rate during initial growth stage and its reduction during subsequent stages may be attained due to fact that during later growth photosynthetic products are mainly utilized for seed filling rather than sustaining higher growth as reported by Bhattacharya and Singh (1999) in chick pea.

The net assimilation rate gradually increased upto 45-60 DAS and decreased from 60-90 DAS(Table.2) The lower values of NAR might be due to much of the dry matter would have gone into non assimilation tissues and senescence. Similar decrease of NAR with age of the crop was also reported by Sestak *et al* (1971) in other crops. Among the early maturing verities tested, LRG 30 recorded highest NAR of 0.824 mg dm^{-2} day^{-1} and there was no significant difference among the late maturing varieties for NAR at harvest. The varietal differences in NAR might be due to changes in leaf area and dry matter production and also partioning of dry matter to non-assimilation tissues. Low magnitude of NAR during post flowering period in chickpea has also been forwarded earlier by Bhattacharya and Singh (1999).

Specific leaf area (SLA) was highest at 15 DAS in all the varieties and decreased at 30 DAS (Table.2). There was a continuous decrease from 75 DAS to maturity in all the varieties .Among the early maturing varieties tested, piler local recorded highest SLA of 86.49 cm^2 g^{-1} and in late maturing varieties LRG 41 recorded highest SLA of 65.01 cm^2 g^{-1} and lowest SLA was recorded in ICPL 8863 (46.05 cm^2 g^{-1}). Specific leaf area is often considered as indirect measure of leaf expansion. Higher SLA means higher leaf area per unit biomass.

SPAD Chlorophyll meter reading (SCMR) is an indication of leaf nitrogen tissue. The SCMR value increased upto 105 DAS in case of early maturing varieties where as in case of late maturing varieties it was increased up to 135 DAS and later decreased.(Table 2). There was significant difference among the varieties for SCMR value at all stages of crop growth. Among the early

Table 1. Growth parameters (LAI, LAD, CGR) of redgram varieties in *rabi*

Varieties	Leaf area Index				Leaf area duration (cm^2 day^{-1})				Crop growth rate (g m^{-2} day^{-1})			
	60 DAS	90 DAS	135 DAS	165 DAS	45-60 DAS	90-105 DAS	120-135 DAS	150-165 DAS	45-60 DAS	90-105 DAS	120-135 DAS	150-165 DAS
ICPL 85063	0.329	0.706	0.431	—	3.59	11.11	9.31	—	1.93	4.50	3.42	—
ICPL 87119	0.276	0.677	0.392	—	3.08	10.77	8.81	—	2.38	7.68	2.26	—
LRG 30	0.365	0.833	0.521	—	4.08	13.02	10.86	—	2.42	5.55	5.79	—
Piler Local	0.376	0.859	0.542	—	4.19	13.34	11.16	—	2.55	11.74	4.60	—
TRG 21	0.279	0.682	0.409	—	3.17	10.70	8.92	—	1.98	5.84	0.90	—
TRG 7	0.261	0.551	0.367	—	2.92	8.75	7.62	—	2.03	7.31	1.38	—
ICPL 8863	0.263	0.557	0.713	0.380	2.96	8.90	10.34	8.50	2.34	4.40	6.71	2.40
PRG 148	0.271	0.674	0.844	0.449	3.07	10.56	12.27	9.96	2.00	5.82	6.92	1.93
LRG 41	0.335	0.791	0.938	0.552	3.78	12.39	13.82	11.32	2.44	6.31	9.91	2.92
TRG 22	0.327	0.768	0.910	0.499	3.67	12.00	13.34	10.75	2.47	5.56	11.58	2.73
CD (0.05)	0.008	0.015	0.123	0.041	0.28	0.23	0.26	0.47	0.07	0.63	2.21	1.04

Table 2. Growth parameters (RGR, NAR, SLA, SCMR) of redgram varieties in *rabi*

Varieties	Relative growth rate (g g^{-1} day^{-1})				Net assimilation rate (mg dm^{-2} day^{-1})				Specific leaf area (cm^2 g^{-1})				SCMR			
	45-60 DAS	90-105 DAS	120-135 DAS	150-165 DAS	45-60 DAS	90-105 DAS	120-135 DAS	150-165 DAS	45-60 DAS	90-105 DAS	120-135 DAS	150-165 DAS	60 DAS	90 DAS	135 DAS	165 DAS
ICPL 85063	0.076	0.025	0.010	—	0.89	0.58	0.57	—	169	145	74	—	43.23	47.8	39.6	—
ICPL 87119	0.080	0.032	0.006	—	1.21	1.09	0.40	—	131	119	66	—	44.0	48.8	42.6	—
LRG 30	0.069	0.025	0.010	—	0.93	0.65	0.82	—	145	127	71	—	45.0	49.9	39.8	—
Piler Local	0.069	0.043	0.008	—	0.95	1.33	0.63	—	147	138	86	—	46.9	51.9	41.5	—
TRG 21	0.081	0.034	0.002	—	0.97	0.82	0.16	—	159	134	75	—	38.0	43.1	33.6	—
TRG 7	0.083	0.040	0.003	—	1.08	1.26	0.28	—	160	113	64	—	36.1	41.1	31.5	—
ICPL 8863	0.078	0.023	0.016	0.004	1.23	0.73	0.97	0.44	120	95	71	46	41.9	46.9	53.2	41.1
PRG 148	0.077	0.028	0.017	0.003	1.01	0.83	0.85	0.30	146	132	94	62	40.6	45.9	52.1	39.9
LRG 41	0.070	0.025	0.020	0.004	1.00	0.75	1.08	0.40	137	118	76	65	44.3	49.4	55.6	43.4
TRG 22	0.073	0.022	0.026	0.004	1.05	0.69	1.30	0.40	151	145	88	61	43.8	49.0	55.1	41.7
CD (0.05)	0.002	0.005	0.005	0.001	0.06	0.09	0.31	0.17	14.7	18.5	12.8	12.4	0.71	0.9	2.3	1.02

Table 3. Yield and yield components of redgram varieties in *rabi*

Varieties	No. pods plant^{-1}	No. seeds pod^{-1}	100 seed wt (g)	Seed yield (kg ha^{-1})	Harvest index (%)
ICLPL 85063	84.5	2.3	10.0	1232	21.32
ICPL 87119	95.1	2.7	11.0	1333	28.73
LRG30	110.1	3.5	8.7	1511	41.16
PILER LOCAL	140.4	3.0	9.3	1672	44.98
TRG 21	64.9	2.8	10.0	1455	31.06
TRG 7	73.1	2.7	9.9	1483	28.79
ICPL 8863	133.5	2.5	11.3	1604	38.53
PRG 148	64.2	2.3	10.2	1190	22.32
LRG 41	161.6	3.7	9.8	1862	47.95
TRG 22	101.8	3.4	10.8	1714	41.66
CD(0.05)	16.8	0.1	0.4	71.3	7.25

maturing varieties tested, ICPL 87119 recorded SCMR value of 42.6. The late maturing varieties, LRG 41 recorded the highest SCMR of 43.4. The decrease of SCMR value may be due to decrease chlorophyll content and such association has been shown in several crops such as groundnut (Bindhu Madhavi *et al* 2003) and cotton. (Veeraputiran *et al* 2001.).

Yield in crop plants is the ultimate expression of many yield attributes and are depended on each other. There was a significant difference between the varieties for number of pods per plant, number of seeds per pod and test weight and seed yield.(Table 3). Among the early maturing varieties tested, Piler local recorded significantly highest seed yield of 1672.7 kg ha^{-1} followed by LRG 30, TRG7, TRG 21, ICPL 87119 and ICPL 85063. Among late mature varieties tested, LRG 41 recorded highest seed yield of 1862 Kg ha^{-1} followed TRG 22, ICPL 8863 and PRG 148. Sharma *et al* (1978) reported that higher yield in *rabi* pigeon pea was due to higher number of pods per plant, more grains per pod and bolder grains. Narayanan and Sheldrake (1979) recorded higher yields from the medium duration varieties. Manila and Bera (1991) reported that LRG 30, ICPL 85063, ICPL 87119, ICPL 8863 have performed well and yields were higher in *rabi* compared to that of *kharif* season. Reddy *et al* (1991) observed significant reduction in yield and yield components when the sowing was advanced beyond 15th October. This may be due to higher temperature during pod development of late sown crop which led to higher respiration rate and there by reduced availability of photosynthate for translocation to the developing seeds. 100 seed weight was more in case of ICPL 8863 (11.3 g) and LRG 30 recorded lowest test weight of 8.7 g. These results were in conformity with the results of Nagamani *et al* (1995).

Harvest index reflects the physiological capacity of a crop to mobilize and translocate photosynthates (Sink capacity) to organs having economic value. There were significant differences among the varieties for harvest index and LRG 41 recorded significant highest HI (47.95%) and in early maturing varieties, Piler local recorded highest harvest Index of 44.98%. The highest harvest index in these varieties might be due to better partitioning of assimilates to sink. . From the above results it can conclude that among the varieties tested, LRG 41 and Piler local recorded highest growth characteristics, yield and yield components during *rabi* season in redgram.

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