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Influence of irrigation regimes and comrade cropping on biochemical composition and yield of cassava, groundnut and sesame

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Abstract : Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore to evaluate the influence of irrigation regimes and comrade cropping on biochemical composition and yield of cassava, groundnut and sesame. Frequent and adequate irrigation at 0.45 or 0.6 IW/CPE ratio increased the starch and total sugar content of cassava and also its tuber yield. The crude protein content of groundnut was significantly low in 0. IW/CPE ratio while its seed yield was maximum at this irrigation regime. The oil content of sesame was maximum at 0.6 IW/CPE ratio where as the seed yield was highest at optimum irrigation regime of 0.45 IW/CPE ratio. Comrade cropping of cassava with either groundnut or sesame did not significantly influence the biochemical composition of any of these crops. The yield of cassava was not affected when revised as comrade crop with groundnut but was drastically reduced when raised with sesame.
(Key Words : Irrigation regimes, comrade cropping, biochemical composition).

Cassava is cultivated in about 0.48 lakh hectares in Tamil Nadu with a production of 1.5 million tonnes of tuber annually contributing about 42 per cent of the national production. Even with the higher contribution to the national cassava production, the productivity (10.25 tonnes ha^{-1}) is far below the normal productivity (19.33 tonnes ha^{-1}) (FAO, 1998) as well as the maximum (40 tonnes ha^{-1}) potential productivity. Inadequate provision of inputs like water and nutrients are the probable reasons for the low productivity. Any attempt to develop a package for efficient irrigation and moisture management may pave way for increasing the productivity of cassava. Cassava being a wide spaced crop with slow initial establishment and canopy coverage provides scope for raising short duration crops at early growth stages particularly under irrigated condition. With a view to accommodate the full population of cassava as well as intercrops, the concept of comrade cropping is being exploited. In this context an attempt has been made to combine scheduling of irrigation and comrade cropping and find its role on the biochemical composition and yield of cassava. groundnut and sesame.

Materials and Methods

The experiment was laid out during 1993 in Eastern Block of Tamil Nadu Agricultural University, Coimbatore. The soil of the experiment site was deep and clayey with moderately well drained condition. The soils were low in available N (103 kg ha^{-1}), medium in available P (18.7 kg ha^{-1}) and high in available K (360 kg ha^{-1}). Cassava variety Co 2 with a duration of nine month, groundnut Co 1 maturing in 105 days and sesame Co 1 with a duration of 90 days were taken up in this study. Treatments on irrigation regimes were designed by taking into account the limited water resource situations. Three irrigation regimes based on irrigation water requirement and pan evaporation values were fixed with a view to study the effect of moisture stress and to optimize the irrigation

requirement. Comrade cropping (comrade cropping means the population of the base crop ie., cassava as well as the population of the intercrop ie. groundnut and sesame will be same. 100 per cent population will be maintained both in base and intercrop) was included to study the possibility of including full population of both base and intercrops for additional benefit.

Irrigation regimes in vertical strips -I_1 : 0.30 IW/CPE ratio, I_2 : 0.45 IW/CPE ratio and I_3 : 0.60 IW/CPE ratio. The depth of irrigation was 5 cm.

Comrade cropping in horizontal strips - C_1 : Sole cassava under 80 x 60 cm, C_2 : Sole cassava under 60 x 80 cm, C_3 : Sole groundnut under 30 x 10 cm, C_4 : Sole sesame under 30 x 30 cm, C_5 : Cassava + groundnut under 60 x 80 cm and C_6 : Cassava + sesame under 60 x 80 cm.

The experiment was laid out in strip plot design with five replications. Irrigation regimes were accommodated in vertical strips and comrade cropping in horizontal strips. The gross plot size was 4.8 m x 4.8 m adopting the spacing according to the treatment schedule. The net plot size was 4m x 4m after discarding borders in all the four sides of the plot. The cassava sets were planted on the top of the ridge with a spacing of 80 x 60 and 60 x 80 cm. The groundnut and sesame seeds were sown on both the sides of ridge (60 x 80 cm) with a plant spacing of 10 cm for groundnut and 30 cm for sesame.

Irrigation was given immediately after planting of cassava and sowing of groundnut and sesame. Life irrigation was given to all the plots on the third day after planting and sowing of comrade crops. Subsequent irrigations were given as per the treatment schedule. For scheduling irrigation based on climatological approach, evaporation rate from USWB Class A Open Pan evaporimeter erected at Agricultural Meteorologic Observatory was recorded every day. Irrigation was given to five cm depth. The amount of irrigation water let into each plot was maintained at six litres sec^{-1} using constant discharge irrigation module fixed at the experimental field. The recommended package of practices were followed for cassava, groundnut and sesame. Tuber yield of cassava, Pod yield of groundnut, Seed yield of sesame, Biochemical parameters like starch content of cassava hydrogen cyanide content of cassava (Indira and Sinha, 1969), total sugar content of cassava, (Mahadevan and Sridhar 1985), oil content of groundnut and sesame and crude protein content in groundnut and sesame were estimated in cassava, groundnut and sesame by selecting five plants at random from net area of each plot. The data were statistically analysed following the procedure described by Panse and Sukhatme (1985) for strip plot design.

Results and Discussion

Effect of irrigation regimes on yield and biochemical composition

Irrigation given either at 0.45 (I_2) or o.6 (I_3) IW/CPE ratio increased the starch content and total sugar content in tuber whereas the poisonous chemical (HCN) content in tuber and rind were reduced due to frequent and adequate irrigation (Table 1). This may be attributed to adequate moisture availability and better crop growth in higher irrigation regimes as observed by Ravindran and James George (1988) in cassava Irrigation given at 0.45 (I_2) and 0.6 (I_3) IW/CPE ratio produced higher tuber yield as compared to 0.3 (I_1) IW/CPE ratio (Table 3). The increase in tuber yield under I_2 and I_3 over I_1 were 25.9 and 28.3 per cent respectively. The reduction in the yield under I_1 (0.3 IW/CPE ratio) may be due to the decrease in the synthesis of metabolites, reduction translocation of nutrients from soil to plant and within plant, decrease in cell division and elongation leading to depression in the grain yield at longer irrigation intervals (El-Bagoury *et al.*, 1984).

Irrigation ratio did not influence oil content of groundnut while crude protein content was significantly influenced (Table 2).. Favourable and adequate moisture availability with 0.6 (I_3) and 0.45 (I_2) IW/CPE ratio resulted in low crude protein content. Similar findings were reported by Abel (1976) in Safflower and Singh *et al.*, (1968) in groundnut. The pod and haulm yield (Table 3) of groundnut were significantly influenced by irrigation levels. Favourable and adequate moisture availability in higher irrigation regime (0.6 IW/CPE ratio - I_3) resulted in higher yield of groundnut. The per cent increase in yield of groundnut in I_3 over I_1 and I_2 was 49.7 and 39.5 per cent respectively. This was in close agreement with Mohamed Ali *et al.*, (1974).

The oil content of sesame increased with higher level of moisture while crude protein content was not much influenced. (Table 2). This is in agreement with Sionit and Kramer (1977) in soybean. Favourable and optimum irrigation regime (0.45 IW/CPE ratio - I_2) resulted in higher seed and stalk yield of sesame (Table 3) while higher moisture regime (I_3) as well as lower moisture regime (I_1)

drastically reduced the yield. This may be attributed to sensitive nature of sesame crop to higher moisture and lack of nutrient uptake and improper crop growth and development under water stress. The findings are in conformity with the findings of Patel and Singh (1979).

Effect of comrade cropping on yield and biochemical composition

Comrade cropping did not significantly influences the biochemical characters like starch, HCN and total sugar content of cassava tuber. Raising cassava as a comrade crop with groundnut did not change the quality of cassava tuber compared to sole cassava (Table 1). When raised as comrade crop with sesame the HCN content of rind of cassava tuber was significantly more. Raising cassava as a comrade crop with groundnut did not have any significant influence on the tuber yield whereas raising sesame as a comrade crop in cassava drastically reduced the cassava tuber yield (Table 3). This might be due to deleterious effect of sesame on cassava. Similar reduction in tuber yield of cassava was observed by Ezumah (1990) when mazie was raised as intercrop in cassava.

The biochemical characters of groundnut and sesame like oil and crude protein content were not altered by comrade cropping, since there was no competition for any resource throughout the growhe period of groundnut and sesame (Table 2). The pod and haulm yield of groundnut and seed and stalk yield of sesame were not affected by raising groundnut or sesame as comrade cropping with cassava (Table 3). This may be attributed to slow initial growth of cassava which could have minimised competition for resources with groundnut and sesame.

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Table 1. Effect of irrigation regimes and comrade cropping on biochemical characters of cassava tuber and rind.

Treatments	Starch content (per cent)	HCN content (ug g^{-1}) in tuber	HCN content (ug g^{-1}) in rind	Total sugar content (per cent in tuber)
Irrigation regimes				
I_1	29.8	27.53	224.82	1.58
I_2	33.3	24.60	203.67	2.28
I_3	34.4	23.57	201.65	2.29
CD (P=0.05)	2.49	1.042	2.447	0.059
Comrade cropping				
C_1	32.8	24.92	208.76	2.07
C_2	32.5	24.87	208.23	2.06
C_3	-	-	-	-
C_4	-	-	-	-
C_5	32.9	25.10	209.05	2.04
C_6	31.9	26.03	214.14	2.03
CD (P=0.05)	NS	NS	1.972	NS

Table 2. Effect of irrigation regimes and comrade cropping on oil and crude protein content of groundnut and sesame.

Treatments	Oil content (per cent)		Crude content (per cent)	
	Groundnut	Sesame	Groundnut	Sesame
Irrigation regimes				
I_1	45.79	49.5	21.09	20.76
I_2	46.80	49.9	20.91	20.86
I_3	46.85	50.5	19.58	20.91
CD (P=0.05)	NS	0.22	0.581	NS
Comrade cropping				
C_1	-	-	-	-
C_2	-	-	-	-
C_3	46.50	-	20.41	-
C_4	-	50.0	-	20.87
C_5	46.55	-	20.65	-
C_6	-	49.9	-	20.82
CD (P=0.05)	NS	NS	NS	NS

Table 3. Effect of irrigation regimes and comrade cropping on yield of cassava, groundnut and sesame.

Treatments	Cassava tuber yield in t. ha^{-1}	Groundnut yield (kg ha^{-1})		Sesame yield (kg ha^{-1})	
		Pod	Haulm	Seed	Stalk
Irrigation regimes					
I_1	22.0	1011	1699	700	1925
I_2	29.7	1671	2604	829	2445
I_3	30.7	2010	2884	572	1790
CD (P=0.05)	1.94	91.8	108.2	34.5	431.7
Comrade cropping					
C_1	30.0	-	-	-	-
C_2	29.8	-	-	-	-
C_3	-	1602	2464	-	-
C_4	-	-	-	726	2120
C_5	28.9	1525	2327	-	-
C_6	21.1	-	-	674	1987
CD (P=0.05)	1.77	NS	NS	NS	NS

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