Table 1. Performance of groundnut Culture ALG 56

Year and season		Pod Yield (kg/ha)		
		ALG 56	Co2	VRI 2
1986	*Kharif*	1815	1505	-
1987	*Kharif*	1950	1800	-
1988	*Kharif*	2250	1792	-
1989	*Kharif*	1748	1680	1690
1989-90	*Rabi*	2250	1907	1950
1990	*Kharif*	2048	1695	1714
1990-91	*Rabi*	3475	3308	3142
1991	*Kharif*	763	758	686
1991-92	*Rabi*	2553	1864	1910
1992	*Kharif*	1374	675	663
1992-93	*Rabi*	1457	1079	1213
1993	*Kharif*	2115	1655	1695
	Mean	1983	1643	1629
Percentage increase over			21	22

In the multilocation trials conducted during 1990-1993 at different research stations in Tamil Nadu, the culture ALG 56 recorded a mean pod yield of 1428 Kg/ha representing an increase of 19 per cent and 6 per cent over Co 2 and VRI 2 respectively. Based on the consistant performance in research stations, the culture ALG 56 was promoted to adaptive research trials and a total of 24 trials was conducted in Pollachi tract during 1991-93. It registered a pod yield of 1915 kg/ha against 1623 and 1641 kg/ha of Co 2 and VRI 2 respectively.

The better yield realised by the culture ALG 56 is due to its field tolerance to rust, late leaf spot and pests like jassids, thrips and leaf miner as compared to checks. ALG 56 is possessing a high oil content upto 52 per cent as against 49.1 and 47.6 per cent possessed by the checks Co 2 and VRI 2 respectively. ALG 56 remains green even after its maturity and yields a good quality fodder. The dormancy period of 15 days possessed by this culture is a boon to the farmers of Pollachi tract where the non dormant varieties may germinate in the field itself due to untimely monsoonic rains at late maturity and harvest phases.

Based on the above desirable features, the culture ALG 56 was approved by the state variety release committee of Tamil Nadu during January, 1994 and released as an improved groundnut variety ALR 2 by the Tamil Nadu Agricultural University, Coimbatore for large scale cultivation.

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ECONOMICS OF RICE CULTIVATION UNDER DIFFERENT LEVELS OF NITROGEN AND WATER MANAGEMENT PRACTICES

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ABSTRACT

Results of field experiment on the economics of water and N management practices on low land rice indicated that grain yield increased upto 150 kg N ha^{-1} in the South West Monsoon (SWM) and Summer seasons. Continuous 5 cm submergence (I_1) or recouping submergence one day after disappearance (I_2) did not influence grain yield during SWM whereas continuous submergence was necessary to record more grain yield during summer. Straw yield recorded were highest with continuous submergence in both the seasons and with 225 kg N ha^{-1} in SWM season and 150 kg N ha^{-1} in summer season. Gross and net returns as well as benefit cost ratio were highest with 150 kg N ha^{-1} in both the seasons. A gross return of Rs.7121/- and 7432 ha^{-1} were obtained with continuous submergence in SWM and summer seasons, respectively, whereas, net return and benefit cost ratio were highest with submergence one day after disappearance of water. The variety IR 50 outyielded CO37 in all the aspects of study. Recouping submergence one (SWM) or three (Summer) days after disappearance of water recorded more return per rupee invested on water and N in both the seasons. Application of N at 150 kg ha^{-1} gave higher return per rupee on water, whereas, the net return per rupee on N decreased beyond 75 kg N ha^{-1}.

Continuous land submergence during the growth period of rice is widely practiced in most of the rice growing areas of our country. But this leads to considerable loss of water through deep percolation and by other means. Reports from IRRI (1984) have clearly pointed out the importance of suitable water management practices in minimising water loss and thus enhancing the productivity. This could be better achieved by reducing the depth of flooding and increasing the gap between successive irrigations. Moreover, most judicious and economic use of irrigation water is highly warranted especially when more than 86 per cent of total irrigation water in Tamil Nadu is diverted for rice cultivation. Apart from water, nitrogen also plays an important role in achieving the production potential of the dwarf high yielding varieties and its economic utilisation is also very important due to its shortage in supply because of the energy crisis in the country. Hence, an investigation was carried on rice to study the economics of scheduling of irrigation with varying levels of nitrogen.

MATERIALS AND METHODS

Field experiments were conducted at the wet lands of Tamil Nadu Agricultural University, Coimbatore, during the South West Monsoon (SWM) 1985 and Summer 1986 seasons. The fields were moderately drained, deep clay loam soil. The available N, P_2O_5 and K_2O were 257.0, 12.4 and 523.0 kg ha^{-1}, respectively. The field had a pH of 8.0 and CEC was 37.9 meg/100 g soil. The experiment was laid out in a strip plot design with three replications. Irrigation x varieties were alloted to one strip and levels of N in another strip. The treatment details are as follows.

Irrigation X Varieties

I_1 : 5 cm continuous submergence

I_2 : Recouping 5 cm submergence one day after disappearance of water.

I_3 : Recouping 5 cm submergence three days after disappearance of water (only during the summer season).

Variety : V_1 - IR 50 V_2 - CO 37

Nitrogen Levels (kg ha^{-1})

N_0 : O
N_1 : 75
N_2 : 150
N_3 : 225 (only during the SWM season)

A uniform dose each of 50 kg ha^{-1} of P_2O_5 and K_2O were applied as basal through super phosphate and muriate of potash. Nitrogen as per treatment was applied as urea in three equal plits as basal, at tillering and at panicle initiation stages. Twenty three day old seedlings were transplanted at 3 seedlings per hill at a spacing of 15 x 10 cm in both the seasons. Shallow submergence of water was maintained for one week for establishment of seedlings and the differential irrigation treatments were started thereafter. The quantity of water applied was measured by using a 7.5 cm portable parshall flume. Irrigation was stopped 15 days before of harvest.

Gross and net income per ha, net return per rupee invested on water and N and benefit cost ratio were calculated based on the cost of cultivation details and input purchase and produce sale records available at the central farm of Tamil Nadu Agricultural University.

a. Cost of cultivation (excluding N and water) = Rs.2750/-

b. Cost of 1 kg urea (N = Rs.4.5) = Rs.2.10

c. Cost of 1 ha cm of water = Rs.10.00

d. Price of 1 kg of rice = Rs.1.05

e. Price of 1 kg of straw = Rs.0.15

Total cost of 1 ha cm of water was calculated as suggested by Sivanappan and Aiyasamy (1978) by substituting present day costs.

RESULTS AND DISCUSSION

Grain and straw yield

The data (Table 1) show that grain yield was influenced by N and variety during SWM whereas all the main effects and interactions exerted influence during summer season. Grain yield increased with N application upto 150 kg ha^{-1} in both the seasons. However, a decline was seen with the highest level of N (225 kg ha^{-1}) in SWM season. In this season, submerging one day after disappearance of water was equally effective as of continuous submergence in producing good rice yield. Continuous submergence consumed a total quantity of 1589 mm of water to produce a grain yield of 4.26t ha^{-1} compared to 1012 mm in the other irrigation level which recorded 4.20 t ha^{-1}.

Thus it has resulted in a saving of about 36.3 per cent or irrigation water by scheduling irrigation to submerge the field one day after disappearance of water during the SWM season under Coimbatore condition. Similar reports were given by Rangasamy *et al.*, (1984) and Sheik Dawood (1986). However, during the summer season highest grain yield was recorded with I_1 followed by I_2 and least by I_3. In this season I_1 required a total quantity of 1608 mm of water while I_2 and I_3 required 973 and 847 mm of water, respectively. The corresponding yield level were 4.44, 4.20 and 3.96 t ha^{-1} with yield reduction under I_2 and I_3 being 5.6 and 11.1 per cent. Water deficits under I_2 and I_3 levels are more severe in upper leaves of rice plant which receives higher solar radiation and wind than in lower leaves. This is especially true in summer season than in SWM season. A total quantity of 123 mm rainfall was received during SWM and in summer season it was only 84 mm. The maximum temperature ranged from 29 to 37^0c in summer, whereas, it was in the range of 27 to 31^0C in the SWM season. The wind velocity range was 4 to 18 kmph in SWM season, whereas, it was in the range of 3 to 25 kmph in the summer season. This showed that continuous submergence was essential for getting higher yield under the agro-climatic conditions prevailing during the summer season in this zone where rainfall is very low, aridity of the atmosphere as indicated by the atmospheric evaporative demands are higher and the percolation losses from the soil assumes a greater magnitude (Sivanappan and Saifudeen, 1976). The variety IR 50 recorded more grain yield than CO 37. It outyielded CO 37 by 5.3 and 5.4 per cent during SWM and summer seasons, respectively. This variety also performed well under all irrigation levels as well as with and without N application compared to CO 37.

Straw yield increased with N application and in both the seasons, the highest yields were recorded by the highest levels of Napplied. Increase in straw yield due to enhanced application of N was reported by Salam (1984). Continuous sub mergence resulted in significant increase in straw yield compared to other irrigation levels. The variety IR50 also produced more straw yield compared to CO 37.

Gross return, net return and benefit cost ratio

Substantial increase in gross return was noticed due to N application upto 150 kg ha^{-1} beyond which a decline was seen in SWM. Continuous submergence resulted in higher gross return due to higher grain yield. The variety IR 50 had higher gross return in both the seasons compared to CO 37.

Net return also increased due to N application upto a level of 150 kg ha^{-1} after which a reduction occurred. Net return was highest with I_2 wherein irrigation was given one day after disappearance of water. It was due to comparativelly higher grain yield with less amount of water required in this treatment (Table 2).

The variety IR50 recorded higher net return than Co37 in both the seasons. Benefit cost ratio was also influenced due to N and irrigation treatments. A similar trend as that of net return was found in respect of benefit cost ratio in both the seasons.

Crops raised during summer season had higher gross and net returns as well as benefit cost ratio compared to SWM and this was due to higher grain and straw yield recorded inspite of higher amount of water consumed during the summer season.

Economics of water and nitrogen

The net return per rupee invested on water decreased with higher levels of irrigation. Submerging one or three days after disappearance of water recorded an increase in return of Rs 1.16 and 1.38 during SWM and summer seasons, respectively, over continuous submergence. Application of N at 150 kg ha^{-1} also resulted in higher return per rupee invested in both the seasons. The data also revealed that there were interactions of N with irrigation and varieties in both and seasons (Table 3).

In the case of net return per rupee invested on N also a similar trend was noticed with respect to irrigation. Submerging one day after disappearance of water resulted in higher return per rupee invested on N in both the seasons. A reduction in net return per rupee invested on N was evident with increase of N level beyond 150 kg ha^{-1}.

Table 1. Grain and Straw yield (kg ha^{-1}) of rice varieties under different water and nitrogen management practices

a. Grain yield

	SOUTH WEST MONSON										SUMMER											
	I_1				Mean	I_2				Mean	I_1			Mean	I_2			Mean	I_3			Mean
	No	N1	N2	N3		No	N1	N2	N3		No	N1	N2		No	N1	N2		No	N1	N2	
V_1	2387	4609	5356	5091	4375	2322	4605	5300	5043	4316	3067	4936	5625	4543	2546	4615	5428	4297	2653	4361	5269	4101
V_2	2396	4453	5145	4798	4146	2122	4373	5090	4721	4477	2559	4695	5580	4345	2433	4463	5389	4095	2395	3833	5191	3803
Mean	2279	4561	5236	4945	4260	2222	4489	5195	4662	4497	2614	4916	5603	4444	2641	4539	5409	4196	2519	4107	5230	3952
I x V_1	2322	4637	5333	5067	4345					I x V_1	2857	4644	5441	4314								
V_2	2459	4413	5118	4760	4113					V_2	2459	4397	5367	4081								
Mean	2256	4525	5226	4914						Mean	2656	4521	5414									

	N	I	V	I x V	N at I	I at K	N at V	V at N
SED (SWM)	44.35	25.75	25.75	42.80	49.06	51.63	49.06	51.63
CD (P=0.05)	108.35	N.S	63.01	N.S	N.S	N.S	N.S	N.S
SED (SUMMER)	12.89	12.56	10.34	17.91	21.24	21.24	17.57	17.23
CD (P=0.05)	35.79	26.21	23.03	39.90	49.71	49.71	43.18	36.34

N.S. Not Significant

b. Straw yield

	I_1				Mean	I_2				Mean	I_1			Mean	I_2			Mean	I_3			Mean
	No	N1	N2	N3		No	N1	N2	N3		No	N1	N2		No	N1	N2		No	N1	N2	
V_1	2476	5355	5813	6170	4954	2459	4947	5430	5513	4588	3192	5415	6792	5133	2942	4755	6113	4603	2762	4470	5492	4241
V_2	2339	5016	5509	5673	4689	2377	4555	5350	5651	4483	2746	5464	6654	4955	2544	4511	5733	4263	2473	4427	5484	4128
Mean	2108	5185	5651	6032	4821	2416	4751	5390	5582	4535	2969	5440	6724	5044	2743	4633	5923	4433	2618	4448	5488	4185
I x V_1	2169	5151	5622	5842	4771					I x V_1	2965	4880	6132	4659								
V_2	2356	4789	5430	5772	4587					V_2	2588	4800	5957	4448								
Mean	2474	4970	5526	5807						Mean	2776	4641	6045									

	N	I	V	I x V	N at I	I at K	N at V	V at N
SED (SWM)	57.87	53.80	53.80	76.09	81.87	89.02	81.87	89.04
CD (P=0.05)	141.62	131.65	131.65	186.18	186.16	196.27	186.16	234.35
SED (SUMMER)	35.78	54.82	78.69	77.52	88.75	97.08	67.66	80.00
CD (P=0.05)	122.13	122.13	175.32	172.72	195.09	208.76	154.21	207.76

Table 2. Economics of rice cultivation under different water and nitrogen management practices

a. Gross return (Rs ha^{-1})

SOUTH WEST MONSOON

	I1				Mean	I2				Mean
	No	N1	N2	N3		No	N1	N2	N3	
V_1	3913	7867	8921	8562	7316	3852	7650	8765	8391	7165
V_2	3645	7432	8544	8081	6926	3540	7243	8438	7929	6788
Mean	3779	7650	8733	8322	7121	3696	7447	8602	8160	6976
I x V_1	3883	7759	8843	8477	7241					
V_2	3593	7338	8491	8005	6857					
Mean	3738	7548	8667	8241						

SUMMER

	I1			Mean	I2			Mean	I3			Mean
	No	N1	N2		No	N1	N2		No	N1	N2	
V_1	5079	8216	9456	7584	4713	7636	9059	7136	4394	7243	8727	6788
V_2	4250	8162	9368	7260	4031	7371	8943	6782	3948	6414	8609	6324
Mean	4665	8189	9412	7432	4372	7504	9001	6959	4171	6829	8668	6556
I x V_1	4729	7698	9081	7169								
V_2	4076	7316	8973	6789								
Mean	4403	7507	9027									

	N	I	V	I x V	N at I	I at N	N at V	V at N
SED (SWM)	60.66	55.72	55.72	78.51	90.57	99.33	90.57	99.33
CD (P=0.05)	148.45	135.85	135.85	192.12	204.34	219.42	204.30	251.02
SED (SUMMER)	24.09	22.59	18.45	31.95	40.83	39.96	33.52	32.63
CD (P=0.05)	66.87	50.34	41.09	71.19	94.97	81.86	81.86	66.64

b. Net return (Rs ha^{-1})

SOUTH WEST MONSOON

	I1				Mean	I2				Mean
	No	N1	N2	N3		No	N1	N2	N3	
V_1	-353	3244	3895	3176	2491	147	3511	4152	3513	2631
V_2	-698	2708	3503	2726	2060	-87	3195	4085	3146	2585
Mean	-526	2976	3699	2951	2275	30	3353	4119	3330	2708
I x V_1	-103	3378	4024	3345	2661					
V_2	-393	2952	3794	2936	2323					
Mean	-248	3165	3909	3141						

SUMMER

	I1			Mean	I2			Mean	I3			Mean
	No	N1	N2		No	N1	N2		No	N1	N2	
V_1	614	3521	4478	2871	986	3565	4663	3071	785	3307	4457	2850
V_2	-169	3557	4355	2581	308	3324	4544	2725	331	2478	4368	2392
Mean	223	3539	4417	2726	647	3445	4604	2898	558	2893	4413	2621
I x V_1	795	3464	4533	2931								
V_2	157	3120	4422	2566								
Mean	476	3292	4478									

	N	I	V	I x V	N at I	I at N	N at V	V at N
SED (SWM)	103.82	95.75	95.75	110.43	126.08	117.36	126.08	117.36
CD (P=0.05)	254.05	234.32	234.32	270.22	294.47	264.54	294.27	278.87
SED (SUMMER)	20.13	20.41	16.67	28.87	42.26	42.40	33.10	34.62
CD (P=0.05)	55.87	45.48	37.13	64.31	94.77	89.94	77.49	73.83

Table 3. Return per rupee invested on water and nitrogen under different water and nitrogen management practices

a. Return on water

	SOUTH WEST MONSOON										SUMMER											
	I_1				Mean	I_2				Mean	I_1			Mean	I_2			Mean	I_3			Mean
	No	N1	N2	N3		No	N1	N2	N3		No	N1	N2		No	N1	N2		No	N1	N2	
V_1	0.77	3.11	3.43	2.96	2.57	1.15	4.34	4.49	4.15	3.53	1.36	3.19	3.88	2.81	2.01	4.63	5.80	4.15	1.91	4.90	6.27	4.36
V_2	0.56	2.65	3.17	2.71	2.27	0.90	4.33	5.40	4.08	3.68	0.90	3.34	3.76	2.66	1.32	4.47	5.67	3.82	1.38	3.92	6.35	3.88
Mean	0.67	2.88	3.30	2.84	2.42	1.03	4.34	4.95	4.12	3.60	1.13	3.27	3.81	2.74	1.67	4.55	5.74	3.99	1.65	4.41	6.31	4.12
I x V_1	0.96	3.73	3.96	3.56	3.05					I x V_1	1.76	4.24	5.32	3.77								
V_2	0.73	3.49	4.29	3.40	2.98					V_2	1.20	3.91	5.25	3.45								
Mean	0.85	3.61	4.12	3.48						Mean	1.48	4.08	5.29									

	N	I	V	I x V	N at I	I at N	N at V	V at N
SED (SWM)	0.07	0.09	0.09	0.12	0.17	0.21	0.17	0.21
CD (P=0.05)	0.17	0.21	N.S	0.30	0.38	0.46	0.38	0.52
SED (SUMMER)	0.10	0.14	0.11	0.19	0.23	0.25	0.18	0.20
CD (P=0.05)	0.27	0.31	0.25	0.43	0.51	0.53	0.40	0.52

b. Return on nitrogen

	I_1			Mean	I_2			Mean	I1		Mean	I2		Mean	I3		Mean
	N1	N2	N3		N1	N2	N3		N1	N2		N1	N2		N1	N2	
V_1	10.60	6.77	4.14	7.17	11.39	7.15	4.47	7.67	11.42	7.63	9.53	11.54	7.91	9.73	10.78	7.60	9.19
V_2	9.01	6.19	3.69	6.30	10.45	7.05	4.11	7.20	11.52	7.45	9.49	10.83	7.73	9.28	8.33	7.47	7.90
Mean	9.81	6.48	3.92	6.73	10.92	7.10	4.29	7.44	11.47	7.54	9.51	11.19	7.82	9.51	9.56	7.54	8.55
I x V_1	11.00	6.96	4.31	7.42				I x V_1	11.25	7.71	9.48						
V_2	9.73	6.62	3.90	6.75				V_2	10.23	7.55	8.89						
Mean	10.37	6.79	4.11					Mean	10.74	7.63							

	N	I	V	I x V	N at I	I at N	N at V	V at N
SED (SWM)	0.16	0.18	0.18	0.26	0.28	0.32	0.28	0.32
CD (P=0.05)	0.45	0.44	0.44	0.63	0.66	0.71	0.66	0.85
SED (SUMMER)	0.04	0.08	0.06	0.11	0.09	0.10	0.07	0.08
CD (P=0.05)	0.18	0.17	0.14	0.24	0.24	0.23	0.21	0.27

c. Benefit cost ratio

SOUTH WEST MONSOON

	I_1				Mean	I_2				Mean
	No	N1	N2	N3		No	N1	N2	N3	
V_1	0.92	1.70	1.77	1.59	1.50	1.04	1.85	1.90	1.72	1.63
V_2	0.84	1.57	1.69	1.51	1.40	0.98	1.79	1.94	1.66	1.59
Mean	0.88	1.64	1.73	1.55	1.45	1.01	1.82	1.92	1.69	1.61
I x V_1	0.98	1.78	1.84	1.66	1.57					
V_2	0.91	1.68	1.82	1.58	1.50					
Mean	0.95	1.73	1.83	1.62						

SUMMER

	I_1			Mean	I_2			Mean	I_3			Mean
	No	N1	N2		No	N1	N2		No	N1	N2	
V_1	1.14	1.75	1.90	1.60	1.26	1.88	1.81	1.65	1.22	1.84	2.04	1.70
V_2	0.96	1.77	1.87	1.53	1.08	1.82	2.03	1.64	1.09	1.63	2.03	1.58
Mean	1.05	1.76	1.89	1.57	1.17	1.85	1.92	1.65	1.16	1.74	2.04	1.64
I x V_1	1.21	1.82	1.92	1.65								
V_2	1.04	1.74	1.98	1.59								
Mean	1.13	1.78	1.95									

	N	I	V	I x V	N at I	I at N	N at V	V at N
SED (SWM)	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
CD (P=0.05)	0.05	0.04	0.04	0.06	0.07	0.07	0.07	0.08
SED (SUMMER)	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
CD (P=0.05)	0.01	0.02	0.02	0.03	0.03	0.04	0.02	0.04

NS : Not significant

Return per rupee invested on water and N was high during summer than in SWM. Thus during summer, for profitable use of water, higher dose of N should be applied compared to SWM season. From the data, it could to suggested that a higher application of N need be done for profitable use of water when the availability of water is not so abundant.

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CALCIUM CONCENTRATION IN DIFFERENT PARTS OF GROUNDNUT *Arachis hypogaea L.* AS INFLUENCED BY LEVELS AND METHODS OF APPLICATION OF GYPSUM

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ABSTRACT

Field experiment conducted at Hebbal, Bangalore, on TMV - 2 groundnut during 1977 and 1978 *kharif* seasons, to study the calcium concentration in different plant parts of groundnut as influenced by levels and methods of gypsum application indicated that the addition of increasing levels of gypsum proportionately increased the concentration of calcium in leaf, stem tissue and in groundnut pods. Application to the sides at flowering resulted in highest concentration of calcium.

In Karnataka, groundnut is usually grown on well drained, light to medium textured soils. These soils are generally low in soil fertility and have low calcium saturation. The importance of calcium in the nutrition of groundnut has long been recognised. The presence of adequate amount of

Table 1. Calcium concentration (per cent) in groundnut leaf tissue on 60th day as influenced by levels and methods of gypsum application during 1977 and 1978.

Levels (tonnes / ha)	1977 Methods: Broad casting	In seed row	Sides of the row	Sides at flowering	Mean	1978 Methods: Broad casting	In seed row	Sides of the row	Sides at flowering	Mean	Mean over two years
0.5	0.60	0.61	0.64	0.93	0.70	0.63	0.65	0.69	1.01	0.75	0.73
1.0	0.61	0.82	0.88	1.01	0.83	0.68	0.72	0.91	1.15	0.87	0.85
1.5	0.88	0.88	0.90	1.25	0.98	0.92	0.94	1.10	1.31	1.07	1.03
Mean	0.70	0.77	0.81	1.06		0.74	0.77	0.90	1.16		
Mean over two years						0.72	0.77	0.86	1.11		
Dusting					0.80					1.05	0.93
Control					0.51					0.55	0.53

	1977 $SE_m \pm$	1977 CD at 5%	1978 $SE_m \pm$	1978 CD at 5%
Levels	0.017	0.05	0.033	0.09
Methods	0.019	0.05	0.038	0.10
General and Interaction	0.034	0.10	0.065	0.19