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Response of farming studies in rainfed finger millet (*Eleusine coracana*) under erratic monsoon conditions of north-western agroclimatic zone of Tamil Nadu

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ABSTRACT

An experiment was conducted during the rainy season or *kharif* of 1999 and 2000 to study the effect of sowing time with different varieties and moisture-conservation practices on growth and yield of rainfed finger millet [*Eleusine coracana* (L.) Gaertn.]. In both the years the dry spell occurred for 15 to 30 days after normal sowing time for rainfed finger millet. The long-duration 'Paiyur 1' finger millet (110 days) sown during normal sowing time recorded low mean grain yield (1,594 kg/ha). But when sowing was done after initial dry spell with 'DPI 2011 ('Dharmapuri') finger millet (95 days) a good grain yield (2,415 kg/ha) was obtained. Among the management practices studied, incorporation of composted choir-pith along with recommended inorganic fertilizers recorded the highest mean grain yield (2,222 kg/ha), followed by the treatment of soil mulch with blade harrow with recommended inorganic fertilizers (2,100 kg/ha). Plant height, number of productive tillers, net income and benefit : cost ratio showed similar trend as that of gain yield.

Key words : Rainfed ragi or finger millet, Response farming, Erratic monsoon, Agronomic management

Rainfall of north-western zone of Tamil Nadu is highly erratic and undependable. The south-west monsoon, north-east monsoon, winter and summer showers contribute 45, 37, 1 and 17% of the annual rainfall respectively. The behaviour of the monsoon is unpredictable with 3 distinct pattern in its occurrence of (i) delayed onset, (ii) occurrence of intermittent dry spell within the crop period and (iii) early withdrawal. This nature of the monsoon poses great difficulty in doing cultivation operations in time and getting good dryland crop becomes almost bleak. Hence, contingent crop-management strategy or response-farming techniques have to be adopted to counteract the abnormal behavior of the monsoon. Encouraging results were reported at Regional Research Station, Paiyur, that *in-situ* moisture-conservation techniques such as seed hardening with cow's urine, random tie

ridging, inter tillage, soil mulching, compartmental bunding and coir-pith incorporations found to improve the rainfed crop yields and income. But no such study involving date of sowing based on rainfall with different varieties in combination with soil moisture-conservation techniques to mitigate the effect of delayed onset and subsequent dry spell occurred during the crop growth. Keeping this in view, the present study was undertaken.

MATERIALS AND METHODS

A field experiment was conducted during the rainy season or *kharif* 1999 and 2000 at the Regional Research Station, Paiyur. The soil was loamy sand with pH 8.2, electrical conductivity 0.4 dS/m, low in available nitrogen (187 kg/ha), medium in available phosphorus (11.9 kg/ha) and high in available potassium (249 kg/ha). Water-holding capacity of the soil was 23.8% with a depth of 75 cm. The experiment was conducted in split-plot design, replicated thrice with 2 dates of sowing in main plots and 4 moisture conservation practices along with a control in subplots. The treatments were M_1, normal sowing with 'Paiyur 1' ragi; M_2, 15 days delayed sowing with 'DPI 2011' ragi (for M_2 15 days was fixed arbitrarily but actually the sowing was taken depending on the receipt of subsequent rainfall); S_1, control; S_2, seed hardening with cow's urine 10% solution; S_3, *in-situ* moisture conservation by random tie ridging at 30-35 days after sowing; S_4, soil mulch with blade harrow at about 30-35 days after sowing; and S_5, composted coir pith incorporation @ 5 tonnes/ha. The duration of 'Paiyur 1'ragi is 115 days with yield potential of 3,125 kg/ha of grain and 5.8 tonnes/ha of straw yields. The duration of 'Paiyur 1' ragi is 115 days with yield potential of 3,125 kg/ha and 5.8 tonnes/ha of straw yields; whereas 'DPI 2011' matures in 95 days with yield potential of 2,450 kg/ha and 4.2 tonnes/ha of grain and straw yield respectively.

For *kharif* 1999 sowing of 'Paiyur 1' ragi done on 18 August 1999 and sowing of 'DPI 2011' was done on 22 September 1999, due to prolonged dry spell. Both were harvested on 24 December 1999. For *kharif* 2000 'Paiyur 1' was sown on 2 August 2000 and 'DPI 2011' was sown on 16 August 2000. 'Paiyur 1' was harvested on 20 November 2000 and 28 November 2000, while 'DPI 2011' on 21 November 2000 and 30 November 2000. The rainfall received during crop period was recorded from the agricultural meteorological observatory available at the station. The soil-moisture percentage was recorded gravimetrically at different stages of crop growth. Plant height, number of productive tillers, number of fingers, ear length, grain yield and straw yields were recorded.

RESULTS AND DISCUSSION

Rainfall

Variations in quantity, time and distributions of rainfall were observed with a total quantity of 499.6 mm and 750.2 mm in 1999 and 2000 crop seasons respectively. Accordingly, the time of sowing varied with the seasons. During 1999 the first sowing was done on 33rd standard week after the receipt of 51.8 mm rainfall. After that there was a continuous dry spell during 1999 from 35th standard week to 37th

Table 1. Standard week-wise rainfall received and rainy days during crop period for rainy (*kharif*) season 1999 and 2000

Standard	Month and date	1999		2000	
		Rainfall (mm)	Rainy days	Rainfall (mm)	Rainy days
31	30 June – 5 July	5.2	1	131.6	6
32	6–12 Aug	9.2	1	43.0	3
33	13–19 Aug	51.8	2	70.6	3
34	20–26 Aug	29.2	2	4.2	1
35	27–2 Aug	-	-	-	-
36	3–9 Sep	-	-	6.4	1
37	10–16 Sep	-	-	40.2	3
38	17–23 Sep	43.6	2	111.4	5
39	24–30 Sep	170.4	5	45.2	4
40	1–7 Oct	55.6	4	141.0	4
41	8–14 Oct	6.0	1	45.4	3
42	15–21 Oct	26.4	3	40.0	1
43	22–28 Oct	31.0	3	19.0	3
44	29 Oct – 4 Nov	-	-	8.0	1
45	5–11 Nov	4.6	1	7.0	1
46	12–18 Nov	-	-	-	-
47	19–25 Nov	42.2	3	32.6	3
48	26 Nov – 2 Dec	24.4	2	4.6	1

Table 2. Soil moisture (%) at different periods as influenced by the management practices (0–30 cm soil depth)

Treatment	I		II		II		IV		V	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
S_1, Control [Recommended inorganic fertilizer (RIF) alone]	15.3	15.5	15.9	16.1	13.5	13.3	15.8	15.4	14.6	14.6
S_2, S_1 + seed hardening with cow's urine 10% solution	15.4	15.2	16.2	16.4	13.5	15.2	15.9	15.8	14.9	14.9
S_3, S_1+ *in-situ* moisture conservation by random tie-ridging	17.5	17.6	18.8	18.5	15.8	16.2	16.8	16.7	15.2	17.3
S_4, S_1+ soil mulch with blade harrow at 30–35 days	17.3	17.8	18.5	18.9	16.1	16.5	18.0	18.0	18.8	17.9
S_5, S_1+ coir-pith incorporation @ 5 t/ha	18.4	18.8	19.1	19.5	16.5	16.9	18.9	18.2	18.2	18.3

standard week (34 days). The second sowing was very much delayed and it was done in 38th standard week after the receipt of 43.6 mm rainfall. But in 2000, the 2 sowings were done with 15-day interval as proposed due to receipt of sowing rains on 31st and 33rd standard weeks with 131.6 mm 70.6 mm rainfall respectively. The

Table 3. Growth and yield of finger millet varieties as influenced by the treatments (rainy season 1999)

Treatment	Plant height at harvest (cm)	Productive tillers/ hill	Productive tillers/ metre length	No. of fingers	Ear length (cm)	Grain yield (kg/ha)	Straw yield (tonnes/ ha)
M_1, Normal sowing with 'Paiyur 1'ragi	70.9	2.0	9.1	7.9	11.9	1,395	3.4
M_2, 15 days delayed sowing with 'DPI 2011' ragi	50.9	3.0	11.3	7.5	8.7	1,832	3.2
CD (P=0.05)	14.4	NS	0.3	NS	1.0	175	NS
S_1 control [Recommended inorganic fertilizer (RIF) alone]	50.2	2.8	9.8	7.3	9.5	1,470	2.9
S_2, S_1+ seed hardening with cow's urine 10% solution	60.9	2.9	9.2	7.4	9.7	1,517	3.1
S_3, S_1+ *in-situ* moisture conservation by random tie-ridging	62.6	2.9	10.6	8.0	9.6	1,580	3.4
S_4, S_1+ soil mulch with blade harrow at 0-35 days	64.4	2.9	10.4	8.0	10.1	1,657	3.5
S_5, S_1+ coir-pith incorporation	66.6	3.2	11.0	8.4	10.5	1,845	3.7
CD (P=0.05)	NS	NS	0.9	0.7	0.7	145	0.4

Table 4. Growth and yield of finger millet varieties as influenced by the treatments, rainy season (2000)

Treatment	Plant height at harvest (cm)	Productive tillers/ hill	Productive tillers/ metre length	No. of fingers	Ear length (cm)	Grain yield (kg/ha)	Straw yield (tonnes/ ha)
M_1, Normal sowing with 'Paiyur 1' ragi	83.6	3.3	10.5	8.1	11.3	1,793	2.5
M_2, 15 days delayed sowing with 'DPI 2011'	76.4	5.6	12.4	7.6	8.2	2,997	2.1
CD (p=0.05)	NS	1.9	0.5	NS	0.9	342	NS
S_1 control [Recommended inorganic fertilizer (RIF) alone]	76.0	3.9	10.8	7.2	9.3	2,106	2.0
S_2, S_1+ seed hardening with cow's urine 10% solution	79.4	4.2	10.9	7.5	9.6	2,317	2.1
S_3, S_1+ *in-situ* moisture conservation by random tie-ridging	80.5	4.3	11.8	8.0	9.7	2,409	2.2
S_4, S_1+ soil mulch with blade harrow at 30-35 days	82.0	4.5	11.9	8.1	10.2	2,543	2.5
S_5, S_1+ coir-pith incorporation	82.3	5.4	12.7	8.5	10.4	2,599	2.6
CD (P=0.05)	5.5	0.9	0.8	0.6	0.8	370	0.5

variations in the quantity of rainfall that received ultimately resulted in variations in the crop yields.

Soil moisture

Moisture percentage in the soil for various moisture-conservation practices was recorded gravimetrically at 15 days interval during vegetative to maturity phase of the crop. In general the soil moisture was 2-3% more in the moisture conservation treatments of composted coirpith incorporation @5 tonnes, random tieridging and soil mulch with blade harrow compared to control. It has provided better subsoil moisture to the ragi crop and ultimately resulted in higher growth and yield, as also reported by Velayudham *et al.*, (1997).

Growth and yield attributes

Significantly tallest plants were recorded in 'Paiyur 1' compared with 'DPI 2011', during *kharif*, 1999, while there existed no variation during *kharif* 2000, recording 83.6 and 76.4 cm in 'Paiyur 1' and 'DPI 2011' respectively. The variation in height could be attributed to genetic nature of the varieties. In *kharif* 1999, the yield parameters such as productive tillers / hill and productive tillers/m length were more in 'DPI 2011'. While the finger number did not vary between the varieties tested. The length of ear was more in 'Paiyur 1' owing to its genetic nature, while in *kharif* 2000 finger number did not vary significantly, but the productive tillers/hill and productive tillers/ m length were more in 'DPI 2011' than in 'Paiyur 1' which recorded 3.3 and 10.5 respectively.

The plant height and number of productive tillers did not vary significantly among the management practices studied during *kharif* 1999. While during *kharif* 2000, the plant height was more in coir-pith incorporation and was on a par with soil mulching with blade harrow and random

Table 5. Pooled grain and straw yields and economics of ragi as influenced by the treatments (mean of 2 years 1999 and 2000)

Treatments	Grain yield (kg/ha)	Straw yield (tonnes /ha)	Net income (Rs/ha)	Benefit : cost ratio
M_1, Normal sowing with 'Paiyur 1' ragi	1,594	3.0	4,960	2.07
M_2, 15 days delayed sowing with 'DPI 2011' ragi	2,415	2.7	8,943	2.92
CD (P=0.05)	308	NS	NA	NA
S_1 control [Recommended inorganic fertilizer (RIF) alone]	1,788	2.5	5,690	2.23
S_2, S_1+ seed hardening with cow's urine 10% solution	1,917	2.6	6,385	2.34
S_3, S_1+ *in-situ* moisture conservation by random tie-ridging	1,995	2.8	6,623	2.34
S_4, S_1+ soil mulch with blade harrow at 30-35 days	2,100	3.0	7,210	2.46
S_5, S_1+ coir-pith incorporation	2,222	3.2	7,720	2.51
CD (P=0.05)	207	0.3	NA	NA

tie-ridging. The tillers/hill was maximum in coir-waste incorporation and was the lowest in the control. The tillers/m^2 length and finger number were more in coir-pith compost incorporation, followed by soil mulch with blade harrow during both the seasons of 1999 and 2000.

Yield

Significant variations in grain yield were observed between the varieties tested. The highest grain yield was recorded in 'DPI 2011'. The straw yield did not vary much between the varieties during 1999. The results indicated that the dry spell occurring immediately after the sowing of 'Paiyur 1' was affected by the reduced growth and yield parameters. While during 2000 the grain yield of 2, 997 kg/ha and 1, 793 kg/ha with the straw yield of 2.1 and 2.5 tonnes/ha were recorded in 'DPI 2011' and 'Paiyur 1' respectively.

In 1999 the treatment of coir-pith compost @ 5 tonnes/ha along with recommended inorganic fertilizers (RIF) recorded the highest grain yield and was significantly higher than the rest of the treatments of soil mulch with blade harrow and random tie-ridging. The straw yield showed similar trend as that of grain yield and was comparable with the yield recorded in soil mulch with blade harrow. Similar trend in yield was recorded in 2000. The straw yield showed similar trend as that of grain yield. More *et al.* (1996) and velayudham *et al.* (1997) also reported higher seed yield with adoption of *in-situ* moisture-conservation measures.

Pooled analysis

The data revealed that in both the years dry spell occurred for 15-30 days after normal sowing time. 'Paiyur 1' (110 days) sown during normal sowing time recorded low mean grain yield of 1,594 kg/ha. Drought during seedling phase affected the grain yield of 'Paiyur 1' but when sowing was done after the initial dry spell with short-duration (95 days) 'DPI 2011', a good yield of 2,415 kg/ha of grain yield was obtained. Parooda and Rai (1991) also reported varietal approaches for minimising the risk in rainfed agriculture. Net income and benefit : cost ratio showed similar trend as that of grain yield, realizing Rs 4,960/ha and Rs 8,943/ha for net income and 2.07 and 2.92 for benefit : cost ratio in 'Paiyur 1' and DPI 2011' respectively. Among the management practices, incorporation of composted coir pith + RIF recorded the highest grain yield (2,222 kg/ha) by RIF + soil mulch with blade harrow.

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