Indian Journal of Agronomy **48** (2) : 111–113 (June 2003)

Effect of tillage practices, organics and nitrogen levels on growth components, dry-matter accumulation and physiological parameters in foxtail millet (*Setaria italica*)

R. BASAVARAJAPPA, A.S. PRABHAKAR AND S.I. HALIKATTI

Department of Agronomy, University of Agricultural Sciences, Dharwad, Karnataka 580 005

Received : December 2001

ABSTRACT

A field experiment was conducted during 1997–98 and 1998–99 at Agricultural Research Station, Hanumanamatti, University of Agricultural Sciences, Dharwad, to know the effect of tillage practices, organics and nitrogen levels on growth components, and dry-matter accumulation and yield in foxtail millet (*Setaria italica* L.) during the rainy season. Among tillage practices, medium tillage and ridging recorded significantly higher height (92.26 cm) at harvest, absolute growth rate (AGR), total dry-matter accumulation (8.783 g/ha) and grain yield (1,307 kg/ha), followed by medium tillage with flat bed sowing. Among organics, enriched FYM + *Azospirillum* recorded higher plant height (86.35 cm), total dry-matter accumulation and grain yield (1,395 kg/ha). Application of 60 kg N/ha recorded significantly higher plant height (91.36 cm), AGR (0.241g/plant/day), total dry-matter production (9.228 g/plant) and grain yield (1,407 kg/ha), followed by 30 kg N/ha and 0 kg N/ha.

Key words : Tillage practices, Organics, Dry-matter accumulation, Grain yield

In recent years, there has been increasing recognition of the importance of millets as a substitute for major cereal crops. In Karnataka, foxtail millet is cultivated in an area of 35.86 thousand ha, producing 28.56 thousand tonnes grain with productivity of 796 kg/ha (AICSMIP, 1997). Foxtail millet is grown in Dharwad, Haveri and Belgaum districts of northern transitional zone of Karnataka (Zone-8).

Tillage is very much essential to loosen the soil, incorporate the soil organic sources as well as to mix the fertilizers in the soil. In doing so the losses of nutrients are prevented by removing the weeds particularly the deep-rooted ones. In recent years, much emphasis has been given for use of organics to produce adequate amount of high quality food. Good-quality farmyard manure (FYM) is perhaps the most valuable organic manure. Green-manuring has been recognized as an efficient agronomic practice for stimulation of various biological transformations in the soil leading to improved soil fertility and health (Pali, 2000). The use of bio-fertilizers has been observed to be effective and improve the yield and other soil parameters.

The low yield of cereals in the Alfisols under rainfed conditions mainly attributed to poor nutrient status of soil, very limited use of nitrogenous fertilizers either through organic or chemical sources coupled with insufficient moisture during crop-growth period.

MATERIALS AND METHODS

A field experiment was conducted on shallow Alfisols (pH 7.0) at Agricultural Research Station, Hanumanamatti, UAS, Dharwad. There were 4 main plots (tillage practices), viz. M_1, shallow tillage (5 cm) with flat bed sowing; M_2, shallow tillage (5 cm) and ridging; M_3, medium tillage (15 cm) with flat bed sowing; and M_4, medium tillage (15 cm) and ridging; 4 subplots (organics), viz. S_1, enriched FYM @ 2.5 tonnes/ha; S_2, enriched FYM @ 2.5 tonnes/ha + *Azospirillium* @ 10 kg/ha; S_3, *Gliricidia* green-manuring @ 5 tonnes/ha; and S_4, control (without organics) and 3 sub-subplots (N levels), viz. 0, 30 and 60 kg N/ha. The total treatment combinations were 48. The experiment was laid out in split-split plot design with 3 replications. Immediately after the receipt of rainfall during April–May tillage treatments, viz. medium tillage to a depth of 15 cm by bullock-drawn mould board plough and shallow tillage to a depth of 5 cm by bullock-drawn harrow were applied. The *in-sittu* moisture conservation treatments, viz. ridges and furrows at 30 cm were formed by bullock-drawn ridger. *Gliricidia* incorporation was made manually during the first week of June and the first week of May during 1997–98 and 1998–1999, respectively, and covered manually. Enriched FYM and nitrogen fertilizers were applied at the time of sowing along the rows. The enriched FYM

was prepared by taking FYM in polyethyene bags and 50% of recommended single superphosphate was added and mixed uniformly and packed tightly in polyethylene bags. The bags kept for incubation or enrichment for a month. The *Azospirillum* @ 10 kg/ha was added to this before sowing. After execution of tillage treatments, 1 week before sowing land was harrowed and soil was brought to a fine tilth. Nitrogen was applied as per the treatments and recommended dose of phosphrous (15 kg/ha) and potassium (15 kg/ha) was applied common to all the treatments at the time of sowing. Fertilizer was applied in furrows opened manually at 30 cm rows to the sowing furrows and covered manually. 'SIA 2642' foxtail millet genotype was used in the present investigation. Required plant population was maintained by thinning the plants at 20 days after sowing (DAS). The inter-cultivation operations were carried out, once at 20-25 DAS and second at 30–35 DAS. Ridging was made as per treatment in the main plots. One hand-weeding was carried out for complete removal of weeds.

RESULTS AND DISCUSSION

Tillage effect on growth and yield

The medium tillage and ridging treatment recorded significantly higher plant height, followed by medium tillage with flat sowing, shallow tillage and ridging and shallow tillage and flat bed sowing (Table 1). Similar trend was obtained for total dry-matter production and absolute growth rate.

The higher TDMP in medium tillage and ridging was attributed to better plant growth with more number of leaves which resulted in higher dry-matter accumulation in leaves and stems at the initial stages (vegetative) and translocation to ear during later stages (reproductive). The results confirm the findings of Anderson (1980). Significantly higher grain yield, straw yield, ear length yield/plant (1.963 g/plant) and 1,000-seed weight were recorded in medium tillage and ridging treatments (Table 1).

Effect of organics on growth components and yield

Enriched FYM + *Azospirillum* applied treatments recorded significantly superior plant height, followed by only enriched FYM, *Gliricidia* green manuring and control.

Enriched + *Azospirillum* applied treatment recorded significantly higher total dry-matter production than *Gliricidia* green, manuring and only enriched FYM. The increase in TDMP due to enriched FYM + *Azospirillum* and only enriched FYM was 35 and 6% respectively, over the control (Table 1). The higher TDMP in enriched FYM + *Azospirillum* applied treatment was attributed to optimum level of soil moisture and biological nitrogen fixa-

Table 1. Growth, yield and yield attributes of foxtail millet as influenced by tillage practices, organics and nitrogen levels (pooled data of 1997–98 and 1998–99)

Treatment	Plant height (cm)	Total dry-matter accumulation (g/plant/day)	Absolute growth rate (g/plant/day)	Relative growth rate (g/g/day)	Grain yield (kg/ha)	Straw yield (kg/ha)	Yield/plant (g)	Ear length (cm)	1,000-seed weight (g)
Tillage practice									
ST-FS	75.81	6.674	0.154	0.017	1,026	2,171	1.51	12.32	3.41
ST-R	79.02	6.987	0.153	0.016	1,115	2,347	1.90	13.32	3.21
MT-FS	84.70	7.050	0.147	0.025	1,209	2,470	1.67	14.00	3.41
MT-R	92.26	8.783	0.214	0.025	1,307	2,635	1.94	15.81	3.54
CD (P=0.05)	0.46	0.097	0.016	NS	37	91	0.04	0.25	0.02
Organics									
E.FYM	84.16	6.991	0.145	0.022	1,152	2,530	1.69	13.60	3.35
E.FYM+Azo	86.35	8.945	0.209	0.019	1,395	2,811	2.24	15.84	3.45
Gly	81.93	7.059	0.156	0.025	1,345	2,652	1.79	14.12	3.42
Control	79.03	6.234	0.159	0.016	763	1,630	1.32	11.89	3.25
CD (P=0.05)	0.73	0.016	NS	NS	32	66	0.02	0.16	0.03
N (kg/ha)									
0	72.71	5.116	0.115	0.019	875	1,889	1.28	12.33	3.02
30	84.56	7.576	0.171	0.020	1,211	2,503	1.79	13.75	3.33
60	91.36	9.228	0.214	0.022	1,408	2,825	2.21	15.72	3.83
CD (P=0.05)	0.63	0.092	0.013	NS	27	57	0.02	0.14	0.05

ST-FS, Shallow tillage flatbed sowing; MT-FS, medium tillage flatbed sowing; ST-R, shallow tillage and ridging; MT-R, medium tillage and ridging; Gly, Gliricidia green-manuring @ 5.0 tonnes/ha; Azo, *Azospirillum* @ 10 kg/ha; control, without organics; EFYM, Enriched FYM; NS, non-significant

tion. It helped the crop for better utilization of added nutrients and produced higher rate of photosynthesis leading to higher total dry-matter production. Our findings support the work of Yoram Kapulnik *et al.* (1981) and Venkateshwaralu and Rao (1984).

Enriched FYM + *Azospirillum* recorded significantly higher grain yield, straw yield, ear length, yield/plant and 1,000-seed weight than rest of the treatments (Tabel 1).

Effect of nitrogen on growth components and yield

Among nitrogen levels, 60 kg N/ha recorded significantly higher plant height, followed by 30 kg N/ha and 0 kg N/ha. Similar trend was observed for absolute growth rate, dry-matter production/plant (Table 1), grain yield, straw yield, ear length, yield/plant and 1,000-seed weight.

Under inadequate supply of nitrogen during active vegetative growth stage, there will be accumulation of carbohydrates as a result photosynthesis was decreased leading to lower total dry-matter production.

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