J. Oilseeds Res., **23**(2) : 234-238 (2006)

Use of soil amendments on productivity of sunflower, castor and sorghum in rainfed environment

G. Subba Reddy, V. Maruthi, M. Vanaja and M. Sree Rekha

Central Research Institute for Dryland Agriculture, Santoshnagar, Saidabad, Hyderabad-500 059, AP

(Received: May, 2001; Revised: May, 2006; Accepted: June, 2006)

Abstract

The studies on effect of soil amendments (FYM and Bentonite) on soil quality and crop growth in sunflower (MSFH-8) was conducted for four *kharif* seasons in rainfed alfisols. The residual effect of these amendments was studied with castor (GCH-4) and sorghum (CSH-6) in rotation during fifth and sixth years. Use of soil amendments on an average increased the seed yields of sunflower by 30-40% over the chemical fertilizer alone. Among the various amendments, FYM @ 10 t/ha/year recorded the highest seed yields followed by bentonite + FYM due to increased growth components and also better use of rainfall and nutrients. Set row application of FYM recorded additional seed grains (12-20%) compared to the broadcast. Use of soil amendments (FYM alone or in combination with bentonite) recorded significant residual effects of 44-56% in castor, sorghum in sequence. These amendments after application for four years substantially improved soil quality parameters like organic carbon, total nitrogen and phosphorus. Set row application of FYM showed higher direct effect on yield, nutrient and water use while there are no variations on yield and quality parameters of castor and sorghum due to residual effect of these amendments.

Key words: Organic amendments, residual effect, sunflower, castor, sorghum

Introduction

Organic manures are the valuable natural resources that can augment the nutrient supplies to starving rainfed crops. The major issues facing Indian agriculture today is enhancement of agricultural production and productivity in a sustainable manner. Maintaining soil health and fertility is essential under intensive cropping system to obtain sustainable high productivity. Exploitation of the potential of organic manures and their synergistic effect with chemical fertilizer is necessary for increasing productivity, sustainability of agriculture and also improving soil health and environmental security. Use of fertilizes in drylands is meagre because of its high cost, certainty of risk and poor economic conditions of the farmers. In rainfed environment fluctuation in yield is due to intermittent moisture and nutrient scarcity and soil organic amendments serve as source of nutrients. The efficacy of these amendments can be enhanced by appropriate methods and times of application. Therefore, it is imperative to make use of organic manures to maintain soil fertility and in sunflower, being an important commercial oilseed crops, maintaining its yield levels even under monocropping is crucial.

Material and methods

A field experiment was conducted from *kharif* for four years in rainfed alfisols of Central Research Institute for Dryland Agriculture, Hyderabad. There were seven treatments applied to sunflower cv. MSFH-8 in 60 cm set rows and non-set rows after adjusting to the level of 50-30-0 NPK kg/ha with chemical fertilizer (Table 1). The residual effects of soil amendments was studied with castor (cv. GCH-4) as a test crop in fifth year and rotated with sorghum (CSH-6) in sixth year in same plots. The soil was sandy loam in texture, low in available nitrogen (210 kg/ha), phosphorus (10 kg/ha) and medium to high in available potassium (210 kg/ha). The initial organic carbon % was 0.51 and 0.53 at 0-15 and 15-30 cm soil depth; while pH was 6.0 and 6.2 at these depths, respectively. The experiment was studied in Randomized Block Design and replicated five times. The growth parameters like drymatter, leaf area index (LAI), nitrogen uptake and yields of crops in different treatments were recorded during the growth stages of crop in each year. The yields of crops in various treatments were recorded in all the years to evaluate the response of the various crops. Soil quality parameters like pH, organic carbon, total nitrogen, phosphorus and water holding capacity were analysed by following standard procedure.

Results and discussion

Rainfall pattern: Sunflower received 513, 505, 610 and 622 mm rainfall during 1st, 2nd, 3rd and 4th years of experimentation, respectively. During first year, the crop has undergone mild stress during vegetative, bud initiation, flowering and at harvest stages. Moderate stress occurred during vegetative and flowering stages in 2nd

year. Bud initiation and flowering stages experienced moderate stress during 3rd year. In 4th year, crop has undergone severe stress during flowering to grain filling stage. Castor in 5th year received 507 mm rainfall during crop growth period with moderate stress at bud initiation and grain filling stages and severe stress at flowering stage. In 6th year sorghum crop received good and uniformly distributed rainfall of 648 mm.

Direct benefits of soil amendments in producing sunflower: There was a marginal increase in the yields from set rows over broadcasting with incorporation of bentonite alone or in combination with FYM while FYM alone gave significant yield increase with set row application (1040 kg/ha) which is 12% over non-set rows application (984 kg/ha). Application of FYM on an average increased the seed yields of sunflower by 57%, while use of bentonite + FYM gave increased seed yield by 21% over the recommended dose of nutrients @ 50:30:0 NPK kg/ha (678 kg/ha) (Table 1). This is attributed to increased drymatter, leaf area index that resulted due to efficient use of rainfall (Fig. 1). Consequently nitrogen uptake of sunflower was highest with FYM in set rows at different crop growth stages, which resulted in more seed yield of sunflower (Singh and Bansal, 1999 and Singh, 1999) (Fig. 2). Bentonite application during all the years had marginal increase in seed yields of sunflower when applied in set rows, which led to water stagnation.

Residual effects of soil amendments: The residual effects of soil amendments over productivity of castor (GCH-4) and sorghum (CSH-6) in sequence was evaluated during 1997 and 1998, respectively. The bean yield of castor was highest with continuous application of Bentonite followed by Bentonite + FYM @ 10 t/ha for each year. Set row application did not show any improvement in yields over braodcasting on castor. In sorghum, soil amendments on an average registered the seed yield gains by 36% than that of chemical fertilizers (1826 kg/ha). FYM and Bentonite individually had affected positively in set rows while in combination, the positive impact was observed with broadcasting and incorporation (Table 1).

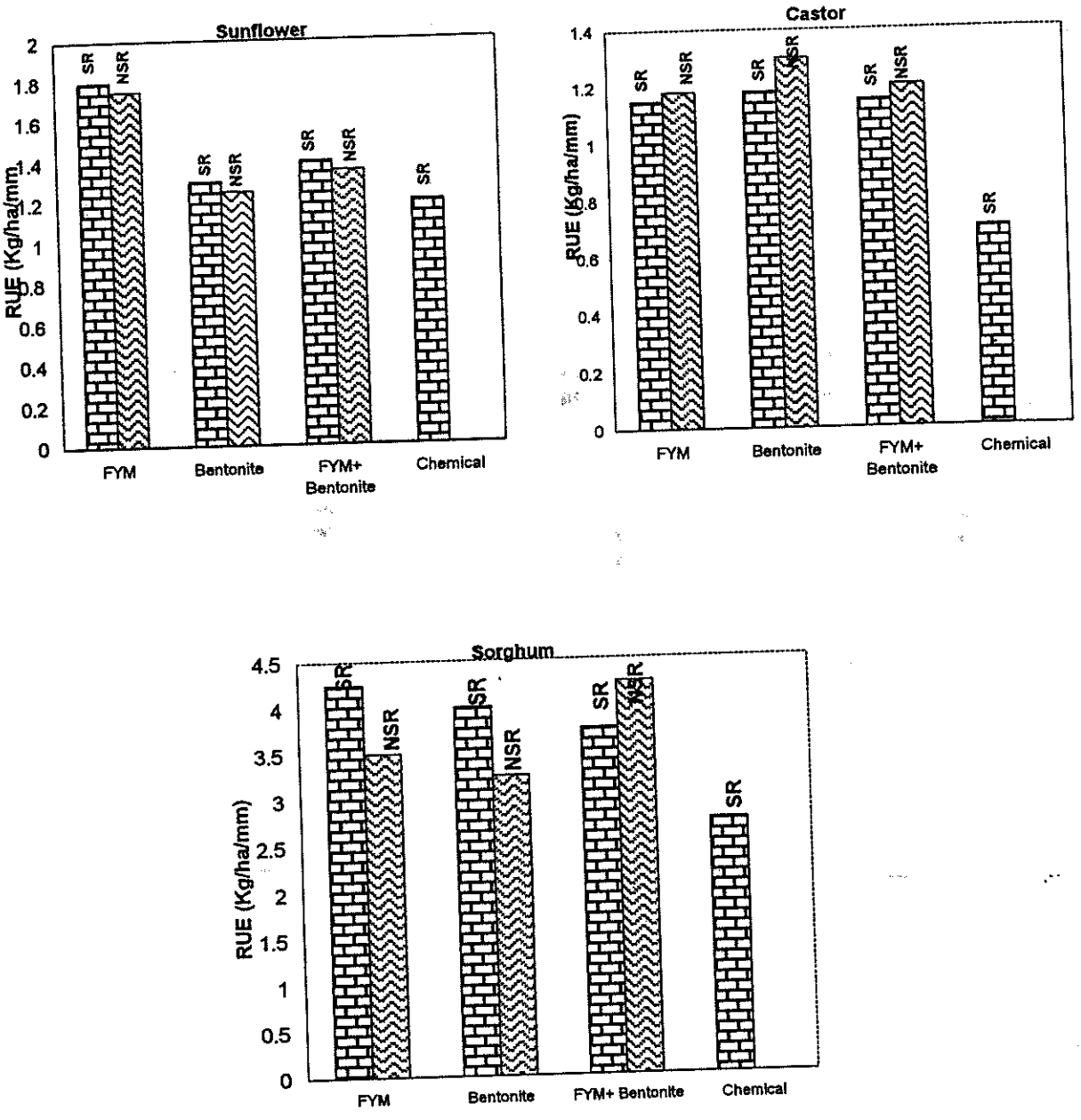
Influence of soil amendments on soil parameters: Continuous application of FYM for consecutive four years period increased organic carbon, N content and water holding capacity of the soil by 5.9, 33 and 8.5% respectively at 0-15 cm soil depth. FYM + Bentonite application recorded highest increase in nitrogen level (66.7%) at 0-15 cm soil depth and also an increase of 8.5% in water holding capacity of the soil (Table 3). Continuous application of nutrients in the form of N:P:K fertilizer alone reduced water holding capacity, organic carbon and N level of soil over base level of nutrients before experiment. Application of nitrogen fertilizers alone to soils had deleterious effect on soil productivity (Anandswarup, 1999). Pattar *et al.* (1999) reported increase in organic carbon nitrogen and phosphorus with FYM application. Continuous application of soil amendments had very little or no effect on P level over initial level, however, the organic carbon and N level showed marginal increase over initial fertility levels.

Table 1 Direct and residual effects of soil amendments on productivity of sunflower, castor and sorghum crops

Treatment	Seed yield (kg/ha)						
	Sunflower					Castor	Sorghum
	1993	1994	1995	1996	Mean	1997	1998
N:P:K (50:30:0) @ kg/ha/year	766	940	558	446	678	378	1826
FYM @ 10 t/ha/year (SR)	1002	1194	1030	932	1040	580	2831
FYM @ 10 t/ha/year (NSR)	1240	1031	915	751	984	596	2335
Bentonite @ 10 t/ha/year (SR)	789	979	638	561	742	580	2671
Bentonite @ 10 t/ha/year (NSR)	864	961	616	534	744	662	2215
FYM + Bentonite @ 10 t/ha/year (SR)	833	1014	801	459	777	567	2452
FYM + Bentonite @ 10 t/ha/year (NSR)	789	1002	790	574	784	618	2803
CD (P=0.05)	50	60	58	53	-	107	185

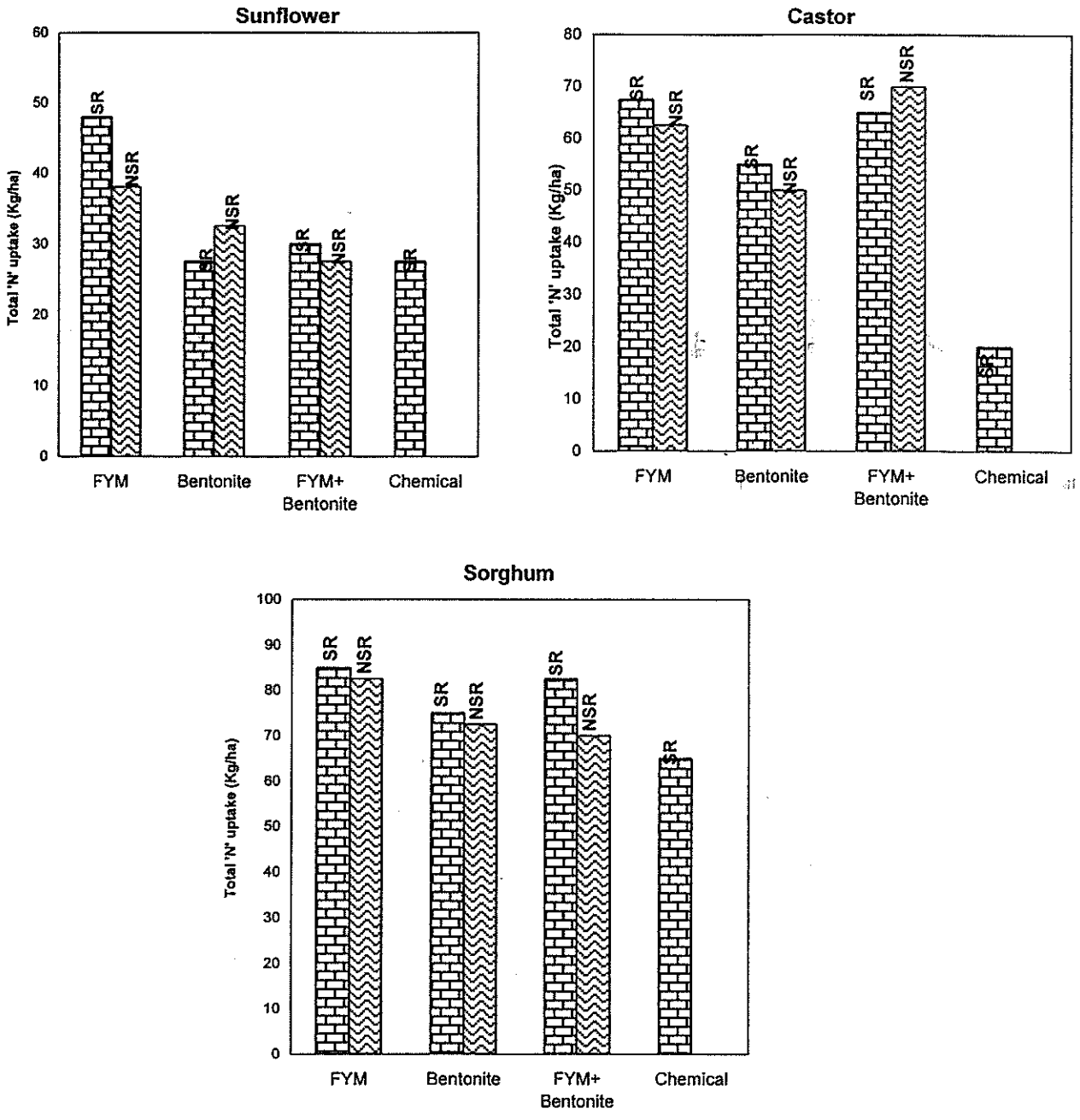
SR : Set rows; NSR = Non-set rows

Fig 1 Effect of sources and methods of application of soil amendaments on Rainfall Use Efficency in rainfed crops.



SR=Set rows, NSR=Non set rows

Fig:2 Effect of sources and methods of application of soil amendments on Nitrogen uptake in rainfed crops.



SR=Set rows, NSR= Non set rows.

Table 2 Residual effect of organic amendments on growth components in sorghum in castor-sorghum rotation and castor in sorghum-castor rotation

Treatment	Drymatter (g/m^2)				Leaf area index			
	Days after sowing				Days after sowing			
	S in C-S		C in C-S		S in C-S		C in C-S	
	30	75	30	75	30	75	30	75
N:P:Kl (50:30:0) @ kg/ha/year	38.0	624.3	27.0	460	0.37	1.44	0.03	0.3
FYM @ 10 t/ha/year (SR)	52.6	835.7	58.8	824	0.71	2.60	0.07	0.3
FYM @ 10 t/ha/year (NSR)	44.6	816.6	60.5	745	0.47	2.58	0.07	0.3
Bentonite @ 10 t/ha/year (SR)	48.3	743.6	44.3	637	0.50	2.56	0.05	0.4
Bentonite @ 10 t/ha/year (NSR)	40.3	670.2	36.9	696	0.42	2.15	0.03	0.3
FYM + Bentonite @ 10 t/ha/year (SR)	46.3	820.1	44.7	635	0.38	2.15	0.04	0.4
FYM + Bentonite @ 10 t/ha/year (NSR)	42.6	888.6	88.0	669	0.39	21.43	0.08	0.3
CD (P=0.05)	21	121	20	170	0.14	0.64	0.03	0.1

SR = Set rows; NSR = Non-set rows

Table 3 Influence of soil amendments on soil parameters in rainfed environment

Treatments	Soil depth (cm)	pH	EC (dS/m)	O.C (%)	Total N (%)	P (mg/kg)	WHC of soil (%)
Initial fertility status (1993)	0-15	6.0	0.06	0.51	0.03	8.2	4.7
	15.30	6.2	0.09	0.53	0.05	4.0	5.5
N:P:K (50:30:0) kg/ha/year	0-15	6.1	0.07	0.50	0.02	7.9	4.8
	15.30	6.3	1.00	0.52	0.03	3.8	5.5
FYM @ 10 t/ha/year (SR)	0-15	6.3	0.08	0.54	0.04	7.9	5.1
	15.30	6.3	0.07	0.56	0.06	4.0	5.8
FYM @ 10 t/ha/year (NSR)	0-15	6.2	0.08	0.53	0.04	8.2	5.0
	15.30	6.3	0.07	0.54	0.06	4.0	5.8
Bentonite @ 10 t/ha/year (SR)	0-15	6.1	0.09	0.48	0.03	7.8	4.7
	15.30	6.2	0.08	0.50	0.04	3.5	5.6
Bentonite @ 10 t/ha/year (NSR)	0-15	6.1	0.10	0.49	0.03	7.8	4.7
	15.30	6.2	0.09	0.50	0.04	3.6	5.6
FYM + Bentonite @ 10 t/ha/year (SR)	0-15	6.25	0.08	0.53	0.04	8.3	5.1
	15.30	6.40	0.07	0.55	0.05	4.0	5.7
FYM + Bentonite @ 10 t/ha/year (NSR)	0-15	6.3	0.08	0.52	0.05	8.4	5.1
	15.30	6.4	0.07	0.55	0.06	4.1	5.8

References

Anandswarup. 1999. Long-term fertilizer experiments. In: *Fifty years of Natural Resources Management Research in India* (eds. G.B. Singh and B.R. Sharma), ICAR, New Delhi, pp.22.

Pattar, P.S., Nadagouda, V.B., Salakinkop, S.R., Kannur, V.S. and Gaddi, A.V. 1999. Effect of organic manures and fertilizer levels on nutrient uptake, soil nutrient status and yield of groundnut (*Arachis hypogaea* L.). *Journal of Oilseeds Research*, **16**(1) : 123-127.

Singh, Shaktawat and Bansal, K.N. 1999. Effect of organic manures and nitrogen on yield and yield, quality and economics of sunflower. *Journal of Oilseeds Research*, **16**(1) : 132-134.

Singh, V.P. 1999. Effect of organic and inorganic sources of nutrients on rainfed wheat (*Triticum aestivum*). *Indian Journal of Agronomy*, **44**(2) : 347-352.