Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences
Volume 1 Number 2: 82-84, 2002

Improvement of Saline Soil Productivity Through Farm Yard Manure Amendment and Coated Seeds for Fodderbeet Cultivation

Banaras, H. Niazi, [1]Jelte Rozema, Badr-uz-Zaman and M. Salim
Land Resources Research Institute, National Agricultural Research Center, Islamabad, Pakistan
[1]Department of Ecology and Ecotoxicology, Free University, Amsterdam, The Netherlands

Abstract: A pot experiment was conducted on saline sodic soil (pH = 9.49, EC = 7.92 dSm^{-1}, SAR = 73.26, ESP = 51.64) to determine the effect of farm yard manure (FYM) amendment on the growth of fodderbeet using two types of seeds i.e. coated and non-coated. Shoot growth was enhanced by the addition of FYM in either non saline or saline sodic soil. Non-coated seeds produced taller plants than coated ones. Root growth was slower than shoot. Number of leaves/plant significantly ($P < 0.05$) increased by the addition of FYM to the soil. Plant fresh and dry weight is increased in the presence of FYM in the soil. Protein and chlorophyll "b" content increased in plants produced from the coated seeds in the presence of FYM treatment.

Key words: Fodderbeet, farm yard manure, saline sodic soil, biomass production, seed coating

Introduction

The nutrients (NPK) present in or added to the soil becomes unavailable to plants due to some reactions with the soil. Soils of Pakistan fix up the nutrients added in the form of phosphate-P in varying degrees and in some soils as high as 98% of the phosphates is fix and made unavailable due to some reactions with the soil (Sharif *et al*., 1966). The crop utilize only 15 to 20% of the applied phosphate and the rest is retained in the form, not readily available (More and Ghonsikar, 1988). The utilization of nutrients by the plant under saline soil conditions is affected by certain factors. Addition of FYM to the soil increases the availability of nutrients to the plant (Sharif *et al*., 1974). Singh and Dubey (1987) have reported that among nitrogen sources, FYM has beneficial effect on wheat production. Organic manure has duel effect on the improvement of soil environment. It not only increases the nitrifying activities of micro-organisms but also decreases nitrogen by increasing cation exchange capacity of soil (Gasser, 1964). Tisdale (1985) has noted a slight decrease in soil pH due to the formation of humic acids which reduce the volatilization loss of NH_3. Most of the reports about the use of FYM for the improved crop production contain data for alkaline calcareous soils of Pakistan (Sharif *et al*., 1966; Sharif *et al*., 1974; Gilani *et al*., 1983; Mian *et al*., 1989; Sandhu *et al*., 1989). Fodderbeet is known to be a salt tolerant during vegetative growth stage but it is sensitive to salinity/sodicity at germination (Niazi *et al*., 1997). Some companies coat the seeds of crops with certain chemicals so that during germination harmful ions of soil solution are restricted to the surface of the seeds to reduce the deleterious effect of higher salt concentration on the germination of salt sensitive seeds.

In this study effect of use of different techniques to avoid the effect of salinity/sodicity at the time of germination for the salt sensitive plant species and the role of FYM in the amelioration of plant growth has been tested during 2000-01.

Material and Methods

Non saline soil was collected from National Agricultural Research Center (NARC), field area, while saline sodic soil was brought from Saline Agriculture Sub-Station, Sadhuke (Table 1). Both the soils were air dried, ground and sieved using 0.5 mesh. Half of the quantity of each soil was separately mixed with the FYM @ 10 t ha^{-1}. In this way four types of soils were prepared i.e., normal soil without FYM, normal soil mixed with FYM, saline sodic soil without FYM and saline sodic soil with FYM. Undrained plastic pots were thoroughly washed with tap water and dried. The pots were separated in four groups. Each group contained ten pots. Each group of pots was filled with 5 kg soil per pot from four different soils. Two types of fodderbeet seeds cv., Majoral i.e., non-coated and coated were sown separately in plastic tubs filled with garden soil for raising the nursery. Four week old seedlings were transplanted to the pots in five replicates of each seed type. The pots were kept in glass house and irrigated to field capacity twice a week. The experiment was conducted in CRD. Plants were harvested two times during the experiment with four week interval. Data were recorded for the plant fresh weight, dry weight, leaf area (Li 3100 Area Meter, Li-Corp. Inc. Lincoln, Nebraska, USA), number of leaves and root/shoot length. Plant material was analyzed bio-chemically for protein (Lowery *et al*., 1951), sugar (Bergmeyer and Brent, 1974) and chlorophyll (Knudson *et al*., 1977). Data obtained were statistically analyzed according to Little and Hills (1972) using MSTATC version 1.42.

Table 1: Physico-chemical characteristics of soils used during the experiment

	Soil	
Properties	Non saline non sodic	Saline sodic
pH	7.62	9.49
EC (dSm^{-1})	1.07	7.92
CO_3^{-}(meq $^{-1}$)	Nil	120.00
HCO_3^{2-} (meq l^{-1})	2.50	732.00
Cl^{-} (meq l^{-1})	7.50	9940.00
Ca^{2+} (meq l^{-1})	10.48	40.00
Mg^{2+} (meq l^{-1})	3.00	14.00
Na^{+} (meq l^{-1})	4.00	2139.00
K^{+} (meq l^{-1})	2.00	31.20
SAR	1.54	73.26
ESP	1.01	51.64
Soil Texture	Loam	Clay loam

Results

Shoot growth was significantly higher ($P < 0.05$) during the first four weeks and plant attained full height. Farm yard manure added to normal or saline soil significantly ($P < 0.05$) promoted the shoot growth due to the high tolerance at vegetative growth stage. Saline soil alone supported the shoot growth compared to control because of the halophylous nature of the plant. A comparatively slower shoot growth was recorded (compared to 1st harvest) during later four weeks. Addition of FYM significantly contributed the plant height in the non saline as well as saline sodic soil during the experiment (Table 2). Root growth was slower than shoot. A significant increase in root length was observed only in normal soil treated with farm yard manure. However development of root was boosted up during 4-8 week under saline sodic soil amended with FYM. Non coated seeds produced non-significantly longer roots than the coated seeds in the presence of FYM (Table 3). Number of leaf was observed to be significantly higher in FYM treated soils (normal as well as saline). During 1st harvest an 11 and 19%increase in the number of leaves in the coated seeds has been observed in the absence and presence of FYM, respectively. In the presence of FYM (non saline soil) the increase in the number of leaves was 58%. This rate decreased to 34% in the saline sodic soil. The number of leaves increased with the growth of plant and an 83 and 43% increase has been observed after 8 weeks in the non saline and sodic soil, respectively. Production of new leaves in plants from non coated seeds continued till 8th week, while plants from coated seeds produced maximum number of leaf till 4th week (Table 4) Interaction of soil treatment of seed type was significant till fourth week. Total increase in the fresh weight of plant was high in FYM treated soil in normal as well as saline conditions. (Table 5). Saline soil, produced as significant higher fresh weight than normal soil regardless of addition of

Table 2: Effect of Farm Yard Manure and seed coating on the height (cm) of fodder beet plant under saline sodic soil condition

		Treatment			
	Seed type	Normal -FYM	Normal +FYM	Saline - FYM	Saline +FYM
Harvest-I	Non-coated	11.82c	40.16a	26.78b	37.60a
	Coated	10.80c	40.64a	27.36b	39.08a
		11.31c	40.40a	27.07b	38.34a
LSD value ($P < 0.01$) for seed type = 6.147, LSD Value ($P < 0.01$) for FYM = 4.347					
Harvest-II	Non-coated	11.82e	42.60a	27.10cd	39.30ab
	Coated	10.84e	41.40a	28.14d	39.22bc
		11.33d	42.50a	27.62c	39.26b
LSD value ($P < 0.01$) for seed type = 6.481, LSD Value ($P < 0.01$) for FYM = 4.583					

Table 3: Effect of Farm Yard Manure and seed coating on the root length(cm) of fodderbeet plant under saline sodic soil conditions

		Treatment			
	Seed type	Normal -FYM	Normal +FYM	Saline -FYM	Saline +FYM
Harvest-I	Non-coated	6.20bc	11.08a	6.48c	5.72c
	Coated	6.56bc	9.60ab	6.08c	5.48c
		6.38b	10.34a	6.28b	5.60b
LSD value ($P < 0.01$) for seed type = 2.963, LSD Value ($P < 0.01$) for FYM = 2.095					
Harvest-II	Non-coated	6.45b	13.38a	8.60ab	12.28a
	Coated	6.62b	9.72ab	6.22b	8.90ab
		6.53b	11.55a	7.41ab	10.59a
LSD value ($P < 0.01$) for seed type = 5.551, LSD Value ($P < 0.01$) for FYM = 3.925					

Table 4: Effect of Farm Yard Manure and seed coating on the number of leaf of fodderbeet plant under saline sodic soil conditions

		Treatment			
	Seed type	Normal -FYM	Normal +FYM	Saline -FYM	Saline +FYM
Harvest-I	Non-coated	8.60cd	13.80a	8.80cd	11.40b
	Coated	7.60d	11.80ab	9.80bc	13.60a
		8.10b	12.80a	9.30b	12.50a
LSD value ($P < 0.01$) for seed type = 2.031, LSD Value ($P < 0.01$) for FYM = 1.436					
Harvest-II	Non-coated	9.20cd	15.40a	10.0bc	14.60a
	Coated	7.60d	15.40a	9.80cd	13.80ab
		8.40b	15.40a	9.90b	14.20a
LSD value ($P < 0.01$) for seed type = 3.080, LSD Value ($P < 0.01$) for FYM = 2.178					

Table 5: Effect of Farm Yard Manure and seed coating on the total fresh weight (g) of fodderbeet plant under saline sodic soil conditions

		Treatment			
	Seed type	Normal -FYM	Normal +FYM	Saline -FYM	Saline +FYM
Harvest-I	Non-coated	3.16b	73.98a	22.28b	59.84a
	Coated	1.96b	56.76a	22.78b	68.14a
		2.56c	65.37a	22.53b	63.99a
LSD value ($P < 0.01$) for seed type = 25.22, LSD Value ($P < 0.01$) for FYM = 17.83					
Harvest-II	Non-coated	3.18d	126.40a	33.78cd	99.24ab
	Coated	2.24d	118.79a	27.32d	74.74bc
		2.71c	122.60a	30.55c	86.99b
LSD value ($P < 0.01$) for seed type = 47.96, LSD Value ($P < 0.01$) for FYM = 33.92					

Table 6: Effect of Farm Yard Manure and seed coating on total dry weight (g) of fodderbeet plant under saline sodic soil conditions

		Treatment			
	Seed type	Normal -FYM	Normal +FYM	Saline -FYM	Saline +FYM
Harvest-I	Non-coated	0.24c	2.30a	1.16bc	1.88ab
	Coated	0.20c	1.90ab	1.18bc	2.60a
		0.22c	2.10a	1.17b	2.24a
LSD value ($P < 0.01$) for seed type = 1.061, LSD Value ($P < 0.01$) for FYM = 0.750					
Harvest-II	Non-coated	0.27d	9.40a	3.64c	7.88ab
	Coated	0.29d	7.00ab	2.16cd	5.18bc
		0.28c	8.20a	2.90b	6.53a
LSD value ($P < 0.01$) for seed type = 3.171, LSD Value ($P < 0.01$) for FYM = 2.242					

Table 7: Effect of Farm Yard Manure and seed coating on average leaf area (cm^2) of fodderbeet plant under saline sodic soil conditions.

		Treatment			
	Seed type	Normal -FYM	Normal +FYM	Saline -FYM	Saline +FYM
Harvest-I	Non-coated	10.21c	103.74a	52.45b	112.35a
	Coated	7.41c	95.70a	52.96b	112.87a
		8.81c	99.72a	52.70b	112.60a
LSD value ($P < 0.01$) for seed type = 28.42, LSD Value ($P < 0.01$) for FYM = 20.10					
Harvest-II	Non-coated	10.68e	144.51a	64.56cd	112.42ab
	Coated	10.53e	131.03ab	59.87de	121.98bc
		10.61d	137.80a	62.22c	117.2b
LSD value ($P < 0.01$) for seed type = 44.81, LSD Value ($P < 0.01$) for FYM = 31.69					

Table 8: Effect of Farm Yard Manure and seed coating on chlorophyll a and chlorophyll b content (mg g^{-1}) of fodderbeet plant under saline sodic soil conditions

		Treatment			
Chlorophyll a	Seed Type	Normal -FYM	Normal +FYM	Saline -FYM	Saline +FYM
Harvest-I	Non-coated	0.377	0.287	0.347	0.378
	Coated	0.377	0.483	0.400	0.307
Non significant		0.377	0.385	0.373	0.347
Harvest-II	Non-coated	0.097	0.073	0.087	0.100
	Coated	0.130	0.127	0.103	0.100
Non significant		0.113	0.100	0.095	0.100

Table 9: Effect of Farm Yard Manure and seed coating on protein content (μg ml^{-1}) of fodderbeet plant under saline sodic soil conditions

		Treatment			
	Seed Type	Normal -FYM	Normal +FYM	Saline -FYM	Saline +FYM
Harvest-I	Non-coated	531.67b	1595.00b	870.00ab	1305.00ab
	Coated	1160.00ab	725.00ab	1305.00ab	1691.66a
		845.8a	1160.00a	1088.00a	1498.00a
LSD value ($P < 0.01$) for seed type = 960.1, LSD Value ($P < 0.01$) for FYM = 678.9					

FYM (Table 5). However, after four week, fresh weight of plant grown in normal soil receiving FYM out yielded all the treatments. Dry weight was also recorded to be higher under all soils except control (Table 6). Under normal soil conditions and FYM amendment coated seeds produced 17% higher dry weight than non coated. The saline sodic soils enhanced the biomass accumulation to 38% in the coated seeds and FYM.

Considering the FYM alone, the dry matter increased upto the 91% in sodic soil when FYM was added. The dry matter yield increased upto 125% till the 8^{th} week of growth (2^{nd} harvest). Average leaf area was significantly greater

in FYM treated soil under non saline as well as saline sodic soil than the plants grown in control. Saline soil without FYM produced less leaf area than soil + FYM in both cases (Table 7). An increase of 114% in the average leaf area has been recorded in the saline sodic soil amended with FYM. With further growth 88% average leaf area was observed till 8th week. There was no treatment effect observed on chlorophyll "a" content. However seed type had a non significant effect on chlorophyll "b" content. Coated seeds produced more chlorophyll than non coated seeds (Table 8). Normal soil + FYM and Saline soil with or without FYM had significantly increased the protein content of the plant (Table 9). Addition of FYM enhanced the synthesis of protein content upto 38%, however, coated seeds produced 29% more protein over non coated seeds.

Discussion

Organic soil amendments like poultry wastes, compost and other sources are known to improve ameliorative effect on chemical, physical and biological properties of moderately sodic soils (Ahmed *et al.*, 1988). Farm yard manure mixed soil increases the nutrients availability to the plant. This increase may be due to the competition of organic ions with different inorganic ions for binding sites on the soil particles and the complex chelating ions like Al, Fe, and Ca and so, precipitating powers of these cations. In a similar process uptake of P also increases with the application of FYM (More and Ghonsikar, 1988). FYM may play a dual part in improving the soil phosphorus status i.e., decreases the adsorption capacity of soil and increases the soluble phosphorus and phosphorus desorption (Sharif *et al.*, 1974). Plant attained maximum height during early growth showing conformity of finding by Niazi *et al.* (1999) under saline soil conditions. The photosynthates were mostly utilized in the energy supply for the cell division and development of shoot for the first four weeks. Translocation of photosynthetic material to root was not effective during this period which resulted in a slower root growth. Later active development of root showed that the materials were actively translocated to the sink. Longer roots produced from non-coated seeds may be justified by a direct emergence and contact with the media while in roots produced from those of coated seeds the emergence of root from the coated material may have taken longer time period and delayed contact with the growth media may have delayed the developmental process of root. The increase observed in the total fresh weight of plant under farm yard manures treated soil in normal and saline conditions may be related to the availability of essential nutrients to the plant, as it was also obvious from the greater number of leaf/plant. A regular new leaf formation in coated seeds till 8th week favored the accumulation of fresh weight of plant increase in leaf area under FYM treated soil showed an other favorable affect on growth of plant by maximum interception of light energy of synthesis of carbohydrates and other energy rich bio - chemical materials. Dry weight accumulation was also significantly higher than control. Addition of FYM promoted the synthesis of protein under saline sodic conditions. The coated seeds also synthesized significantly higher protein content than non saline soil even in the absence of FYM. The chlorophyll a and b content produced in plant did not show any significant effect of salinity/sodicity FYM or coated seeds. It is in collaboration with the findings of Papp *et al.* (1983). The coated seed has shown some positive behavior in avoiding the deleterious affects of sodicity and the growth was ameliorated in the plants produced from coated seeds in the presence of FYM. It may has helped the availability of nutrients to plants.

References

Ahmed, M., B. H. Niazi and G. R. Sandhu, 1988. Effectiveness of gypsum, HCl and organic matter for the improvement of saline sodic soils. Pak. J. Agric. Res., 9: 373-378.

Bergmeyer, H. U. and E. Brent, 1974. Sucrose. In: H. U. Bergmeyer (Editor), Methods of enzymatic analysis. Academic Press Inc. New York, 3: 1176-1179.

Gasser, J. K. R., 1964. Some factors affecting losses of ammonia from urea and ammonium sulphate applied to soil. J. Soil Sci., 15: 258-272.

Gilani, R. H., M. A. Mian, S. Muhammad and A. Ghani, 1983. The fertilizer phosphate utilization efficiency in wheat production. Pak. J. Soil Sci., 1: 7-9.

Knudson, A. A., J. W. Tibbit and G. E. Edwards, 1977. Measurement of ozone injury by determination of leaf chlorophyll concentration. J. Plant Physiol., 60: 606-608.

Little, T. M. and F. I. Hills, 1972. Statistical Methods in Agricultural Research. Univ. of California, Davis, pp: 242.

Lowery, O. H., N. J. Rosenbrough, A. L. Farr and R. J. Randall, 1951. Protein measurement with the folin phenol reagent. J. Biol. Chem., 193: 265-275.

Mian, S. M., M. Mahmood-ul-Hassan and M. Salim, 1989. Comparison of poultry and farm yard manure for improving efficiency of single super-phosphate applied to wheat. Pak. J. Agric. Sci., 24: 466-473.

More, S. D. and C. P. Ghonsikar, 1988. Effect of some organic manures on the availability of phosphorus to wheat. J. Ind. Soc. Soil Sci., 36: 372-374.

Niazi, B. H., J. Rozema and M. Salim, 1999. The response of fodderbeet to salinity: An analysis of physiological and morphological aspects of growth. Pak. J. Biol. Sci., 2: 466-471.

Niazi, B. H., J. Rozema, M. Salim, Badr-uz-Zaman, A. Ali and Rahmatullah, 1997. Evaluation of seabeet and fodderbeet for cultivation on salt affected soils. Pak. J. Soil Sci., 13: 70-74.

Papp, J. C., M. C. Ball and N. Jerry, 1983. A comparative study of the effects of NaCl salinity on respiration, photosynthesis and leaf extension growth in *B. vulgaris* L. (sugarbeet). Plant Cell and Environ., 6: 675-677.

Sandhu, G. R., S. Ahmad and M. Ahmad, 1989. Salinity in Agriculture. V. Drainage requirements and Systems. Prog. Farming, 9: 27-33.

Sharif, M., F. Muhammad and M. A. Chaudry, 1966. Higher availability of super-phosphate fertilizer by mixing with farm yard manure. Nucleus, 3: 72-74.

Sharif, M., F. M. Chaudhary and A. Latif, 1974. Suppression of super-phosphate phosphorus fixation by farm yard manure. I. High phosphorus uptake from super-phosphate. Soil Sci. pl. Nutr., 20: 187.

Sing, R. S. and S. D. Dubey, 1987. Direct, residual and cumulative effect of FYM and NPK application on yield and nutrient uptake in wheat. J. Ind. Soc. Soil Sci., 35: 745-747.

Tisdale, S. L., W. L. Nelson and J. D. Beaton, 1985. Soil fertility and Fertilizers. The Macmillian Company, NY., pp: 754.