

Fodder Beet – A Nutritive and High Yielding Fodder Crop Suitable for Salt Affected Soils of Arid Regions

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Abstract: An experiment was carried out to study the suitability and yield potential of fodder beet (*Beta vulgaris* L.) in Western Rajasthan for the first time. Under saline irrigation (EC 4 dS m⁻¹), a very high productivity was achieved i.e. fresh fodder yield of 61 and 72.1 t ha⁻¹ harvested at 120 and 150 days after sowing, respectively. Proximate analysis was also carried out and it was found to be an energy rich nutritive fodder. Compared to wheat crop, salt build up was less under fodder beet cultivation (1.11 dS m⁻¹). Therefore, considering huge potential of this crop for producing excellent quality fodder as well as phyto-amelioration of salt affected soils even under saline irrigation this crop should be promoted in arid regions where livestock based farming system is a norm.

Key words: Fodder beet, productivity, phyto-amelioration, saline irrigation.

Livestock plays a major role in lives of arid zone farmers, as they are appropriate for drought proofing. Under drought years agriculture production may ebb as low as 10% of the normal year, whereas livestock production may still remain more than 50% under same condition. Arid zone of Rajasthan supports a livestock population of 29.08 million that requires about 30.83 Mt fodder/year, of which at least 4.0 to 4.5 Mt of green fodder is needed to optimize the livestock productivity. However, the overall deficit for green fodder in western Rajasthan ranges between 78 to 93% (Pratap Narain and Kar, 2005). Further, with the establishment of milk collection centers in almost every village of arid zone, a large number of farmers have started rearing high yielding animals, i.e. cross-bred cattle and buffalo in the region for which green fodder is a must. A negative energy balance is recorded in these high yielding animals along with multi-nutrient deficiencies. This is mainly due to non-availability of green forage and hence their full yield potential is not realized. A range of fodder crops like pearl millet, sorghum chari, etc. are available during kharif season, however the choice is very limited during rabi season due to scarce and poor quality irrigation water.

Fodder beet (*Beta vulgaris* sub sp. *maritima*) is grown in many parts of world mainly for sugar,

fodder and vegetable. It is salt tolerant and probably the highest biomass producing crop in saline environments. In desert landscape of Egypt studies revealed that feeding sheep and goats on fodder beet roots can maintain animal productivity, and save about 50% of ration concentrate feed mixture and increase milk yield and its component (Mousa, 2011). Various studies indicated its suitability as energy rich fodder for dairy animals also (Mathew *et al.*, 2011). There are reports that this crop has a potential for vegetative bioremediation of salt affected soils where not much water is available for leaching (Tarek *et al.*, 2008). In India beet crop was introduced in 1960. Once beet was a popular crop in Hanumangarh and Sriganganagar districts of Rajasthan. A sugar factory was also established with beet as a raw material. However, with the closure of that factory, this crop has gone out of cultivation. Realizing its fodder value and phytoremediation potential, this study was conducted to assess its adaptability in arid regions of India.

Materials and Methods

A field experiment was conducted during rabi season of 2011-12 at Central Arid Zone Research Institute, Regional Research Station, Pali-Marwar. The experimental soil was fine loamy in texture, mixed hyper-thermic belonging to the family Lithic Calciorthids having 30-45 cm depth and dense underlying layer of *murrum* (highly calcareous weathered granite fragment coated with lime) up to 10-15

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Table 1. Productivity of fodder beet at different crop durations

Crop duration (days)	Average root size (kg)	Average yield (t ha ⁻¹)
120	1.6-2.3	61.0
150	2.4-3.1	72.6

m depth. The soil was having 1.42 mg m⁻³ bulk density, 17.1% field capacity, 7.1% permanent wilting point and 12 mm hr⁻¹ infiltration rate. It had 7.6 pH, 0.35% organic carbon, 200.0 kg ha⁻¹ available N, 10.6 kg ha⁻¹ Olson's P and 225.0 kg ha⁻¹ NH₄OAc-K content in 0-15 cm depth. The irrigation water was having pH 7.45 and EC 4.0 dS m⁻¹ and SAR 7.9. Fodder beet variety JK Kuber was sown on 10th November 2011. A population of 75 thousand plants per hectare was achieved by keeping a seed rate of 2.5 kg ha⁻¹. The crop was sown on beds of 40 cm width and 15 cm height with 30 cm wide furrows prepared by bed planter. A plant to plant spacing of 20 cm was maintained and two seeds were sown per hill at 2-4 cm depth. After sowing, the field was immediately irrigated and care was taken that irrigation water does not flow over the ridges. As the crop is a heavy feeder of nutrients, 150:60 kg ha⁻¹ nitrogen and

of beet plants is quite slow during first two months therefore timely removal of weeds is utmost requirement for this crop.

Hence two hand weedings were done at 30 and 50 days after sowing. It has been considered to be affected by root rot (*Sclerotium rolfsii*) and foliage damaging insects. However, no such damage was recorded in this experiment. The first uprooting was done 120 days after sowing, i.e. on 10th March 2012. The second uprooting was done on 9th April 2012. Fresh fodder beet, including leaf and root, were fed @ 15-20 kg per cattle per day along with other fodder material. Beets were also chopped and dried for feeding the animals during summer months. The soil EC, pH and SAR of saturation extract from fodder beet plots after harvest were analyzed using standard procedures and compared with properties of field where wheat was sown conventionally and on beds of similar sizes and fallow land.

Results and Discussion

During first harvest at 120 days after sowing, the average size of beet was 1.6 to 2.3 kg per plant with an average yield of 61 t ha⁻¹, which

Table 2. Proximate analysis of fodder beet

	Dry matter (%)	Crude protein (%)	Fat (%)	Fiber (%)	Ca (%)	P (%)
Roots	17.0	5.7	0.8	3.6	0.1	0.1
Leaves	2.0	16.5	2.7	25.0	0.8	0.2

phosphate along with 15 kg zinc sulphate ha⁻¹ were applied. Entire quantity of phosphorus and zinc and one-third of nitrogen were given as basal dose before sowing and remaining nitrogen was applied as top dressing in two equal doses 30 and 45 days after sowing. Irrigation was applied fortnightly and in all 6 irrigations were given. Being a multi-germ variety beet often produced 3-4 plants per seed and therefore thinned to produce one robust plant per hill. As the growth and development

increased to 72.6 t ha⁻¹ when harvested at 150 DAS (Table 1). The majority of beets were of size between 2.4 to 3.1 kg ha⁻¹, although beets as heavy as 4.5 kg were also common during second harvest. When compared to lucerne cultivated in the region beet required less water both in frequency and amount, tolerated poor quality water, more palatable to animals and yielded higher. However, lucerne was available for feeding from December end, whereas beet availability came after the end of January.

Table 3. Effect of fodder beet on soil after harvest of crop

Crops	EC (dS m ⁻¹)		pH		SAR	
	0-10 cm	10-20 cm	0-10 cm	10-20 cm	0-10 cm	10-20 cm
Fodder beet	1.11	0.95	7.45	7.59	5.30	6.10
Wheat (bed planted)	1.81	0.81	7.46	7.7	9.5	6.43
Wheat (conventional planted)	1.65	0.84	7.45	7.8	5.49	6.60
Fallow	0.74	0.85	7.40	7.53	5.30	5.82

The proximate analysis of leaves and roots of beet was carried out (Table 2) indicating a rich source of energy. Similar values were also reported by Singh and Garg (2012).

Soil analysis after the harvest of crop indicated that fodder beet can be a potential source of bioremediation of saline water irrigated soils (Table 3). The soil EC in upper 10 cm reached only to 1.11 dS m⁻¹ compared to 1.81 and 1.65 dS m⁻¹ under wheat grown over beds and conventional tilled fields, respectively. It was at par with the salt load in fallow soils. Similar trend was observed for pH and SAR. This might have occurred due to higher extraction of salts (particularly Na and Cl) and improved the hydraulic conductivity of soil as evident from higher salt concentration in lower layer (10-20 cm soil depth). This hypothesis was based on the experimental findings of Tarek *et al.* (2008, 2013). They reported higher amount of salts in ash content of fodder beet and improved hydraulic conductivity compared to millets and adequately leached soil columns. Accordingly, soil electrical conductivity was considerably decreased in these studies by 54–69% compared with the untreated soil.

It may be concluded that fodder beet cultivation is successful in western Rajasthan and can provide energy-rich fodder to the animals from March to May. Fodder beet is

a potential crop for efficient bioremediation of saline calcareous soils. Studies on its tolerance limit for saline soils and irrigation water need further investigation. Large scale demonstrations are needed to popularize the crop in arid regions.

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