Annals of Arid Zone 37(4): 377-382, 1998

# Performance of Fodder Beet in Oman

**S.K. Nadaf, Y.M. Ibrahim, M. Akhtar, M.G. El Haj and A.H. Al-Lawati**
*Directorate General of Agricultural Research, Ministry of Agriculture and Fisheries, P.O. Box 467, PC 113, Muscat, Sultanate of Oman*

**Abstract**: Three fodder beet (*Beta vulgaris* var. Crassa) genotypes, viz., Peramono, Petra and Anissa, were evaluated for their productivity, feeding value and quality, during winter 1994-95 and 1995-96 at both Agriculture Research Center (ARC) and Livestock Research Center (LRC) at Rumais, Sultanate of Oman. These three genotypes were not significantly different for yield and yield associated characters at both the locations. The yield of fodder beet genotypes at ARC (94.62 to 110.88 t $ha^{-1}$ and 136.41 to 151.08 t $ha^{-1}$, respectively, during 1994-95 and 1995-96), having loamy sand soil with irrigation water of over 5000 m mhos $cm^{-1}$, were more than those at LRC (72.90 to 79.34 t $ha^{-1}$ and 102.74 to 120.87 t $ha^{-1}$, respectively, during 1994-95 and 1995-96) having loamy soil with irrigation water of about 2000 m mhos $cm^{-1}$. Fodder beet tubers were nutritive and could be a good source of carbohydrates. It is recommended to chop beet tops and tubers as both intake and milk production were improved by chopping.

**Key words**: Fodder beet, intake, nutritive value, productivity.

Fodder beets, also called mangels, are popular in many countries like New Zealand, Germany, America, Australia, Syria and Egypt as these yield more than 80 t $ha^{-1}$ under favourable conditions (Shalaby *et al.*, 1989) with an average of about 40-50 t $ha^{-1}$ in 60-80 days (Anonymous, 1994). Fodder beets possess 10-15% dry matter. Fodder beets, when managed properly, may produce 20 t $ha^{-1}$ of dry matter in one harvest as compared to 13 to 15 t $ha^{-1}$ from 4 cuts of grass (Kiely *et al.*, 1991). Fodder beet tops and roots are succulent, palatable and easily digestible and liked by most of livestock (Chatterjee and Das, 1989). Fodder beets are also tolerant to salinity and perform well under saline soils (Shalaby *et al.*, 1989).

Increasing fodder beet in the diet of lactating cows increased the digestible energy and decreased digestible protein and crude fiber (Darwish *et al.*, 1989). The chemical composition of fodder beet varies between cultivars, and growing conditions.

The fodder beet was recently introduced in the Sultanate of Oman to evaluate its productivity under the prevailing adverse soil and water conditions. Hence, the present investigation was carried out mainly to evaluate the performance of the crop as a competitive fodder, with the existing popular forage crops like Rhodes grass and alfalfa.

## Materials and Methods

Three Italian fodder beet genotypes, viz., Peramono, Petra and Anissa, were evaluated at Agriculture Research Center (ARC) with loamy sand soil and Livestock Research Center (LRC) with loamy soil, both centers

located at Rumais in the Sultanate of Oman, during winter, 1994-95 and 1995-96. The trial was laid in RCBD with eight replications at ARC and LRC, respectively, on 11.11.1994 and 14.11.1994 and with six replications at ARC and LRC, respectively, on 8.11.1995 and 28.11.1995. Each entry was planted in 3 m long seven rows at a spacing of 50 x 20 cm. The seed rate was 4 kg $ha^{-1}$. The crop was fertilized with 80 kg N, 60 kg $P_2O_5$ and 60 kg $K_2O$ $ha^{-1}$ in the form of urea, triple super phosphate and potassium sulphate. The entire potassium and phosphatic fertilizers, along with half the nitrogen fertilizer, were applied before sowing, while the remaining nitrogen was applied a month after sowing. At ARC, the crop was irrigated to field capacity 2 to 3 times a week with water of over 5000 m mhos $cm^{-1}$, accounting for a total of 255 mm, while at LRC, the crop was irrigated with water of about 2000 m mhos $cm^{-1}$ for two hours at three day interval, accounting for a total of 230 mm, till harvest. The crop was harvested between 70-85 days after sowing.

The observations on leaf top length, tuber length, tuber diameter, leaf top weight, tuber weight and fresh fodder yield were recorded at harvest. Samples were analyzed for chemical composition and nutritive value. The fodder was fed to dairy cows and both feed intake and milk production were recorded. The data were subjected to statistical analysis following Gomez and Gomez (1984) using MSTAT computer program.

## Results and Discussion

The mean data of 1994-95 on fresh fodder yield and some yield attributes for each of three Italian fodder beet genotypes evaluated at ARC and LRC, along with statistical parameters are presented in Table 1, while the pooled two year-data of fresh

*Table 1. Yield and associated characters of fodder beet genotypes at ARC and LRC during 1994-95*

| Genotype | Plant height (cm) | Root length (cm) | Root diameter (cm) | Leaf wt./plot (kg) | Root wt./plot (kg) | Fodder yield (t $ha^{-1}$) |
|---|---|---|---|---|---|---|
| **At ARC** | | | | | | |
| Peramono | 44.75 | 18.50 | 10.87 | 1.20 | 1.25 | 110.88 |
| Petra | 46.50 | 22.33 | 12.54 | 1.12 | 1.42 | 94.62 |
| Anissa | 39.17 | 18.42 | 10.62 | 0.66 | 0.99 | 107.56 |
| F-TEST | NS | NS | NS | NS | NS | NS |
| LSD(5%) | – | – | – | – | – | – |
| CV(%) | 15.46 | 27.15 | 28.92 | 48.19 | 52.78 | 18.96 |
| **At LRC** | | | | | | |
| Peramono | 53.99 | 24.42 | 10.71 | 0.88 | 1.03 | 72.90 |
| Petra | 49.33 | 25.38 | 10.21 | 0.69 | 0.69 | 73.77 |
| Anissa | 43.38 | 24.08 | 10.20 | 0.91 | 1.02 | 79.34 |
| F-TEST | NS | NS | NS | NS | NS | NS |
| LSD(5%) | – | – | – | – | – | – |
| CV(%) | 6.54 | 6.58 | 8.94 | 13.05 | 18.32 | 17.34 |

fodder yield over the locations, along with the ANOVA components of pooled analysis, are given in Table 2. At both the locations, yield and yield attributes of three fodder beet genotypes were comparable and the differences were not significant. However, they are different with respect to tuber colour as Peramono and Petra had red tubers, while Anissa had white ones.

The results of pooled analysis for the fresh fodder yield data over two locations clearly indicated that the performance of genotypes was significantly different at two locations. At ARC, fresh fodder yield of genotype Peramono was the highest (110.88 and 151.02 t $ha^{-1}$) in both years followed by Anissa (107.56 t $ha^{-1}$) and Petra (94.62 t $ha^{-1}$) during 1994-95 and, Petra (143.31 t $ha^{-1}$) and Anissa (136.41 t $ha^{-1}$) during 1995-96. The leaf top length varied between 39.17 cm (Anissa) and 46.50 cm (Petra); tuber length between 18.42 cm (Anissa) and 22.33 cm (Petra); tuber diameter between 10.62 cm (Anissa) and 12.54 cm (Petra); leaf top weight $plant^{-1}$ between 0.66 kg (Anissa) and 1.20 kg (Peramono) and tuber weight $plant^{-1}$ varied between 0.99 kg (Anissa) and 1.42 kg (Petra). At LRC, Anissa produced highest fresh fodder yield of 79.34 t $ha^{-1}$ during 1994-95 followed by Petra (73.77 t $ha^{-1}$) and Peramono (72.90 t $ha^{-1}$) while during 1995-96, Peramono produced the highest fresh fodder yield of 120.87 t $ha^{-1}$ followed by Anissa (116.55 t $ha^{-1}$) and Petra (102.74 t $ha^{-1}$). The leaf top length varied between 43.38 cm (Anissa) and 53.99 cm (Peramono); tuber length between 24.08 cm (Anissa) and 25.83 cm (Petra); tuber diameter between 10.20 cm (Anissa) and 10.71 cm (Peramono); leaf top weight $plant^{-1}$ between 0.69 kg (Petra) and 0.91 kg (Anissa) and tuber weight $plant^{-1}$ varied between 0.69 kg (Petra) and 1.03 kg (Peramono). These results clearly showed

*Table 2. Fresh fodder yield (t $ha^{-1}$) of three fodder beet genotypes during 1994-95 and 1995-96 at two locations*

| Genotype | Year 1994-95 | | Year 1995-96 | |
|---|---|---|---|---|
| | ARC | LRC | ARC | LRC |
| Peramono | 110.88 | 72.90 | 151.02 | 120.87 |
| Petra | 94.62 | 73.77 | 143.31 | 102.74 |
| Anissa | 107.56 | 79.34 | 136.41 | 116.55 |
| F-Test | NS | NS | NS | NS |
| S.Em (±) | 06.99 | 04.62 | 18.70 | 16.72 |
| CV | 18.96 | 17.34 | 22.56 | 25.78 |

Pooled analysis over the location:

| | 1994-95 | 1995-96 |
|---|---|---|
| Genotypes | NS | NS |
| Locations | ** | * |
| Replications in location | NS | NS |
| Genotypes x Locations | NS | NS |
| S.Em (±) | 4.57 | 10.79 |

*Table 3. Nutrient composition of fodder beet genotypes*

| Genotype and part of plant | DM (%) | CP (%) | CF (%) | EF (%) | ASH (%) | NFE (%) |
|---|---|---|---|---|---|---|
| **Peramono** | | | | | | |
| Leaves | 8.50 | 11.40 | 10.80 | 2.50 | 28.10 | 50.30 |
| Tubers | 10.00 | 9.80 | 6.30 | 0.30 | 13.00 | 73.00 |
| **Petra** | | | | | | |
| Leaves | 10.10 | 15.80 | 10.10 | 2.40 | 25.20 | 43.70 |
| Tubers | 15.50 | 4.50 | 5.80 | 0.20 | 15.00 | 81.00 |
| **Anissa** | | | | | | |
| Leaves | 9.40 | 12.00 | 10.30 | 2.40 | 26.40 | 49.90 |
| Tubers | 14.00 | 8.00 | 5.80 | 0.30 | 14.80 | 78.10 |

that the yields were higher at ARC, than at LRC, in both the years because of higher leaf top weight and tuber weight.

The preliminary investigations on the nutritive value of fodder beet genotypes (Table 3) indicated that the tubers were nutritious and could be a good source of carbohydrates. The tubers were very rich in starch (NFE) and low in crude fiber (CF) as compared to the leaves. Crude protein (CP) content of the leaves was higher than that of Rhodes grass in all the three genotypes and it ranged between 11.4 and 15.8%, while the tubers contained between 4.5 and 9.8% of crude protein. However, dry matter (DM) content was very low, particularly in leaves, and it ranged between 8.5 and 10.1% as compared to that of Rhodes grass (20-25%). Calculated energy content of fodder beet (tubers+leaves) was about 61% TDN as compared to 58% for Rhodes grass.

The studies on chemical composition of these fodder beet genotypes revealed that the leaves had more ash content (25-28%) as compared to the tubers (Table

*Table 4. Chemical composition of three fodder beet genotypes*

| Genotype and part of plant | Contents | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ash | N | P | K | Na | Cl | Zn | Fe | Cu | Mn | Ca | Mg | S |
| | ----------(%)---------- | | | | | | ----------(ppm)---------- | | | | --------(%)------- | | |
| **Paramono** | | | | | | | | | | | | | |
| Leaves | 28.10 | 1.72 | 0.25 | 3.80 | 10.12 | 8.50 | 48.00 | 1286.00 | 10.00 | 74.00 | 0.36 | 1.22 | 0.92 |
| Tubers | 13.00 | 0.89 | 0.29 | 3.32 | 3.60 | 1.50 | 54.00 | 296.00 | 10.00 | 30.00 | 1.26 | 0.59 | 0.91 |
| **Petra** | | | | | | | | | | | | | |
| Leaves | 25.20 | 1.65 | 0.29 | 3.26 | 8.70 | 4.70 | 32.00 | 776.00 | 12.00 | 40.00 | 0.33 | 0.95 | 0.91 |
| Tubers | 15.00 | 0.88 | 0.29 | 2.98 | 3.82 | 1.80 | 38.00 | 320.00 | 10.00 | 26.00 | 1.45 | 0.63 | 0.91 |
| **Anissa** | | | | | | | | | | | | | |
| Leaves | 26.40 | 1.69 | 0.27 | 3.31 | 9.16 | 5.30 | 38.00 | 851.00 | 11.00 | 42.00 | 0.31 | 1.10 | 0.93 |
| Tubers | 14.80 | 0.87 | 0.29 | 3.10 | 3.78 | 1.61 | 45.60 | 310.00 | 10.00 | 29.00 | 1.38 | 0.67 | 0.91 |

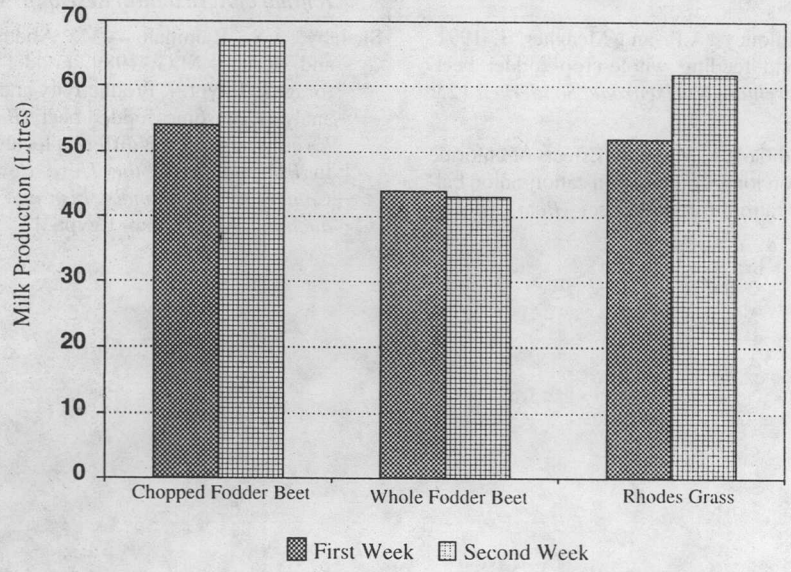


*Fig. 1. Milk production of cows fed on fodder beet and Rhodes grass.*

4). In respect to Mn, Fe, Cl or Na, the leaves had higher contents than tubers, while contents of N, K, Mg were slightly higher in leaves than in tubers for all genotypes, whereas, the amount of Zn was slightly higher in tubers. However, the contents of P, Cu and S were similar in both leaves and tubers. This contradicted the findings of Magat and Goh (1990) which showed that chloride fertilizers consistently increased root K and Cl concentrations but not K in tops. The studies on feeding value utilizing fodder beet (whole and chopped) and Rhodes grass, for two subsequent weeks, revealed that milk production in respect of feeding chopped fodder beet (54.30 L and 67.00 L) was almost similar or higher than that in feeding Rhodes grass (52.10 L and 62.30 L). The milk production, however, in respect of feeding whole beet, was very low (Fig. 1).

## References

Anonymous. 1994. *Annual Reports of Agricultural Research*, Department of Agriculture Research, Ministry of Agriculture and Fisheries. Sultanate of Oman.

Chatterjee, B.N. and Das, P.K. 1989. *Forage Crop Production: Principles and Practices*. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.

Darwish, A., Hassouna, M.M.E., Rammah, A.M. and El Gawad, M.A.S.A. 1989. Fodder beet roots in restricted rations for lactating cows. In *Proceedings of the Third Egyptian British Conference on Animals, Fish and Poultry Production.* 15: 221-229, Alexandria, Egypt

Gomez, K.A. and Gomez, A.A. 1984. *Statistical Procedures for Agricultural Research*. Second

Ed. The International Rice Research Institute, Philippines.

Kiely, P.O., Moloney, A.P. and Meagher, J. 1991. Ensiling and feeding whole-crop fodder beet. *Landbauforchung-Voelkenrode, Sonderheft* 123: 269-272.

Magat, S.S. and Goh, K.M. 1990. Effects of chloride fertilizers on ionic composition cation-anion balance and ratio of fodder beet (*Beta vulgaris* L.) grown under field conditions. *New Zealand Journal of Agricultural Research* 33(1): 29-40.

Shalaby, A.S., Rammah, A.M., Abdul-Aziz, G.M. and Beshay, M.G. 1989. Fodder beet, a new forage in Egypt. 1. Productivity and the chemical analysis of some fodder beet (*Beta vulgaris L.*) cultivars sown at different locations in Egypt. In *Proceedings of the Third Egyptian British Conference on Animals, Fish and Poultry Production*. Alexandria, Egypt 13: 133-143.