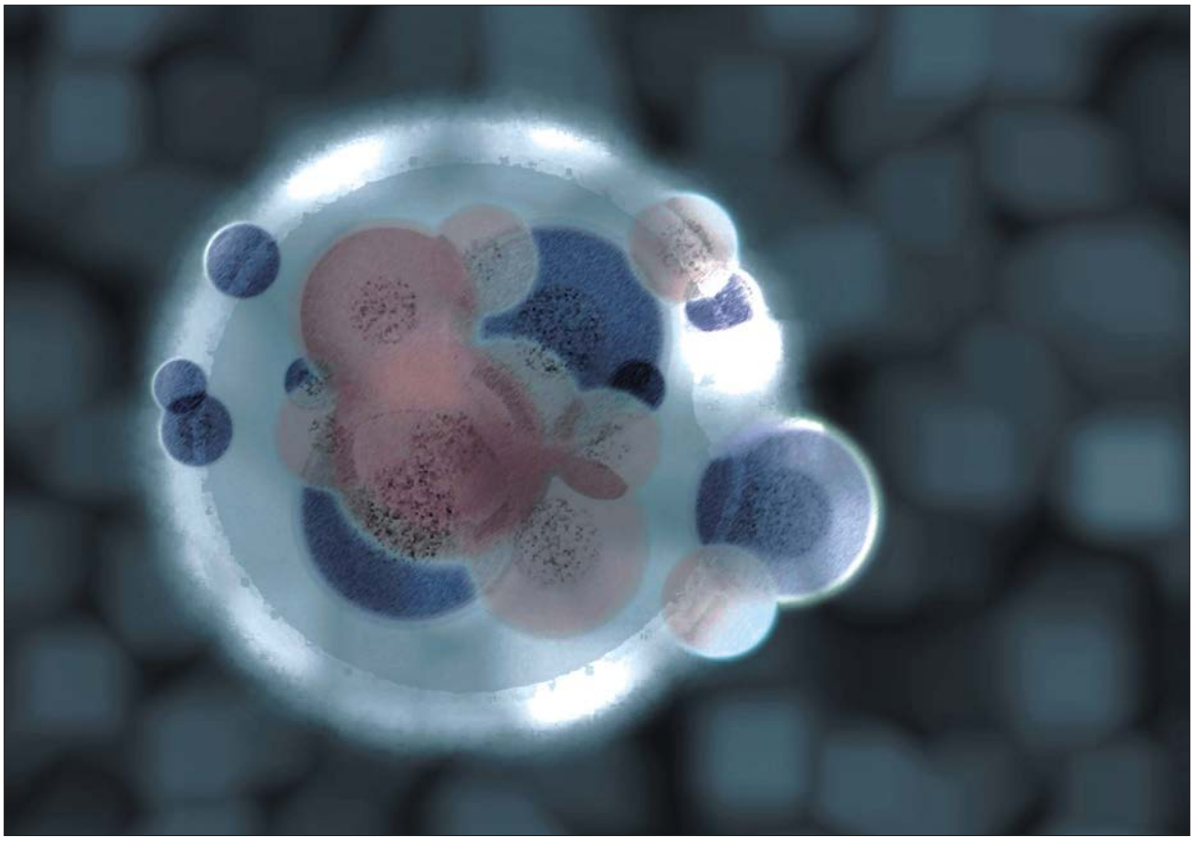

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Evaluation of Introduced Fescue Grass for Forage and Soil Conservation in Hilly Areas of Pakistan

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Abstract: Three species of fescue grass *Festuca rubra, Festuca pratensis* and *Festuca arundinaceae* were evaluated for their potential to produce green herbage and to control the soil erosion. Three parameters including number of tillers, fresh and dry weight per plant in different cuttings during whole season (March-September) were investigated. *Festuca arundinaceae* showed its potential for maximum production of tillers as well as the values of fresh and dry weight during all cuttings in a season followed by *Festuca pratensis* and *Festuca rubra*. However, the latter two species were found to be early growing in spring and persist during late fall. The fescue grasses also produced good rooting system to hold the soil. The combination of fescue grasses with other species will have significant effect in increasing the period of green forage availability in national pastures and holding the soil prone to erosion because of over-grazing and lack of cover during winter. The species could also be utilised in future forage breeding programmes in the country.

Key words: Fescue grass, *Festuca rubra, Festuca pratensis*, *Festuca arundinaceae*, forage, soil erosion, tillers, fresh weight, dry weight

Introduction

Pakistan constitute about 49.5 million hectare range lands out of 76.61 million hectare total arable land. These areas spread all over the country from sea coasts of Balochistan to high altitudes of Himalayas in Kashmir. But most of the area is rainfed and lies under temperate climatic zone (Ahmad and Chaudhry, 1995). Most of the cattle's (19.09 million) in Pakistan are supported by rang lands, either wholly or partially. About 200,000 families are involved in rearing livestock's and therefore, directly earn their livelihood from the range lands (Anonymous, 1988). Our range lands are facing many problems including, short duration of production season, soil erosion, drought and non availability of the productive perennial forage species. The existing species are only productive during monsoon season, consequently the animal herds are poor in health and produce very low yield of meat and milk. These problems are common every where in the world, however the planned research activities yielded dividends elsewhere except in the developing countries like Pakistan. There is no shortage of potential germplasm with inherent ability to withstand the drought, frost and soil erosion problems in the world. There is need to introduce potential species like *Festuca* and *Lolium* and their hybrids in conjunction with the local species of grasses and legumes for year round availability of forage and the control of soil erosion (Ahmad and Chaudhry, 1995; Mahmood *et al*., 1997).

The fescues comprises of a large genus out of which about 100 species are belonging to the temperate zone. Many of the species are used for forage, turf and conservation purposes. Three potential species of fescue, tall fescue, meadow fescue and red fescue were introduced at University College of Agriculture Rawalakot from Europe. Tall fescue (*Festuca arundinaceae* 2n = 42) is native to Britain and meadow fescue (*Festuca pratensis* 2n= 14) is native to Europe (Clapham, *et al.,* 1962) whereas the red fescue (*Festuca rubra* 2n = 42) is native to Europe and temperate Asia (Mahmood *et al*., 1997). Due to their ability to withstand harsh environmental conditions i.e. persistence, adaptation, long grazing season, and resistance against insects and diseases, fecues were introduced in many countries of the world. Tall fescue is mainly used as pasture, hay, silage and soil conservation despite the decline in succulency or water contents in tall fescue with the growing season (Wilkinson *et al*., 1987; Hunt, 1961). Only in USA the production of clean seeds of tall fescue was 56,824,367 kg in 1975 (Buckner and Bush, 1979). Meadow fescue is abundant in meadows and low laying grasslands and is quite tolerant of high water tables (Clapham *et al*., 1962). It is less adapted as compare to tall fescue but is still recognised as an excellent pasture grass in Europe. Meadow fescue when frequently cut or grazed gives herbage of high digestibility similar to that of perennial ryegrass (Hunt, 1961). However the water contents in green herbage may reduce in late season (Stahlin and Daniel, 1965). It is winter hardy and grows early in spring therefore excels tall fescue as a full season grass. It is used for pasture, hay soil conservation and turf purposes. Red fescue is well adapted to well drained, modestly shaded and droughty infertile acid soils . Red fescue is widely used as turf grass but is also used in mixed pastures. It is used for soil conservation because it develops a dense turf and tolerate trampling, therefore, is valuable for soil erosion control (Nordestgaard, 1986; Mahmood *et al.,* 1997). The genus *Festuca* and *Lolium* are closely related and are agronomically important species thus have a great potential for forage and soil conservation from the breeding standpoint (Jouhar, 1987). The aim of the investigation was to evaluate the introduced species of fescue grass under local conditions for its forage and soil conservation potential in order to commercialise the grass for increasing the duration of green forage availability in the range lands of Pakistan.

Materials and Methods

The seeds for three species of *Festuca* namely *Festuca rubra* (UCR_1-V4), *Festuca pratensis* (UCR_2-V3) and *Festuca arundinaceae* (UCR_3-V2 and UCR_4-V1; two varieties) were originally provided by Professor D.G. Jones Chairman Agricultural Sciences, University of Wales Aberystwyth U.K. The plants were maintained and multiplied at the farm of University College of Agriculture Rawalakot Azad Kashmir and seeds were procured and used for further investigations. The experiment was conducted during the years 1996-1997. The seeds were sown in plots using Randomised Complete Block Design (RCBD) (Steel and Torrie, 1984). Three characters vis. number of tillers/plant, fresh weight and dry weight were used to compare the species for their agronomic performance. Five randomly selected plants from each row (25 plants from each replication) were used for data collection. The number of tillers/plant were counted at 4 different times and the duration

between two cuttings was kept 50 days (Motazedian and Sharrow, 1986; Carrow and Troll, 1977). The same plants were used for measuring the fresh and dry weight using electric balance. For dry weight the harvested plants after taking fresh weight were packed in Kraft paper bags and placed in an oven at 100°C for 24 hours before taking their weight. Harvesting of plant for each cutting was done approximately 6cm above the ground level, so that the new tillers may emerge easily by the growth of meristimatic tissues (Carrow and Troll, 1977).

Results and Discussion

Three species of Festuca tall fescue (UCR3-V1, UCR4-V2), meadow fescue (UCR2-V3) and red fescue (UCR1-V4) were investigated. The experiment was performed under natural conditions without any additional inputs including fertilizers, as the farmers near about the pastures cannot afford additional cost of inputs. Number of tillers per plant was greater in tall fescue species (V1 and V2) compared to red and meadow fescue observed for 4 harvestings/cuttings (Fig. 1). Tall fescue (*F. arundinaceae*) excelled meadow (*F. pratensis*) and red fescue (*F. rubra*) in fresh and dry weight components as well (Fig. 2, 3).

In Fig. 1-3, the least significant difference for four cuttings in each variety and between four varieties of *Festuca* are compared respectively. Figure 3a indicates that the number of tillers increased significantly from first to third cutting in each variety but declined in the fourth cutting. However, it was non-significant in V4 (UCR1) with similar trend. The *Festuca rubra* is known to be adapted to well drained soils and is mostly used for turf and mixed pastures (Mahmood *et al*., 1997), its low performance may be due to the low laying moist soil in the present investigation. When the comparisons for tillering capacity in four cuttings were made among the species/varieties compared, it was found to be highly significant in three cuttings but was non significant in the fourth cutting (Fig. 3b). All species produced maximum tillers at third cutting i.e. between June and August. This period is ideal for all grasses because of the high temperature and moisture in monsoon season in Pakistan. Such observations were reported elsewhere in case of *Festuca* species by Jewiss and Wolfdge (1967). The tiller number was increased after each cutting in all species, except in fourth cutting where tiller number was found to be reduced. The reduction in tiller number at fourth cutting is understandable. As due to the advent of fall period in September onward senescence started and some auxiliary tillers were weithered away. The rate of tiller production was found to be highest in species of *Festuca* immediately after the flowering as already reported by Robson (1962). It has been reported (Wilkinson *et al*., 1987: Elwell and Stocking, 1975) that densely tillering grasses covered the soil well and greatly reduce the soil erosion. Both varieties of *F. arundinaceae* (V1 and V2) were highly persistent and showed drought tolerance and stoughtness compared with *F. rubra* (V4) and *F. pratensis* (V3). Similarly the total number of tillers/plant was found to be larger in this species (V1 and V2) which would imply that the species is highly suitable for forage as well as soil erosion control. *F. pratensis* (V3) on the other hand is known to be most persistent, digestible and is equally productive during early spring and late fall (Nordestgaard, 1986; Hunt, 1961), also showed steady performance in this investigation, thus showed suitability for grazing and soil erosion control.

The fresh weight/plant for 4 cuttings and the comparisons

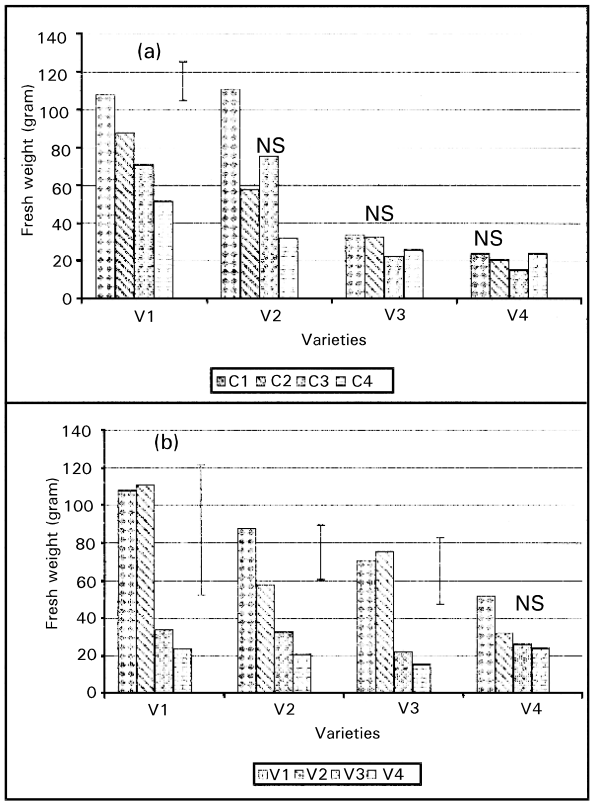

Fig. 1(a-b): Fresh weight (grams) of different varieties of Fistuca grass at different cuttings under Rawalakot. (a) LSD indicates least significant difference ($p < 0.05$) of different cuttings within individual variety (b) indicates least significant difference ($p < 0.05$) among different varieties

among four varieties for the same are presented in Fig. 1a and 1b). The figures indicate the maximum fresh weight/plant was in tall fescue (V1 and V2) followed by meadow (V3) and red fescue (V4). There was significant difference among the cuttings in UCR4 but the difference was not significant in case of UCR3, UCR2 and UCR1 (Fig. 1a). The comparisons among the varieties showed significant difference for 3 cuttings but the difference for 4th cutting was non significant (Fig. 1b). The reason has been already explained as during the fast growing season (April to August) the tall fescue (*F. arundinaceae*) performed very well compared to early spring and late fall. However, the meadow (*F. pratensis*) and red fescue (*F. rubra*) give steady performance even during early spring and late fall (Clapham *et al*., 1962; Hunt, 1961). The fourth cutting was taken after August therefore, the difference among varieties was minimum. *F. pratensis* (V3) showed decline in fresh weight value from 1st to 3rd cutting as already reported by Stahlin and Daniel (1965) but fourth cutting was again giving higher value which indicates its better performance during late fall (Nordestgaard, 1986). *F. arundinaceae* (V1) on the other hand showed continuous decline from 1st to 4th cuttings. This is conformed by Hunt (1961). The trend for dry weight/plant was also similar to that of fresh weight values in all species compared

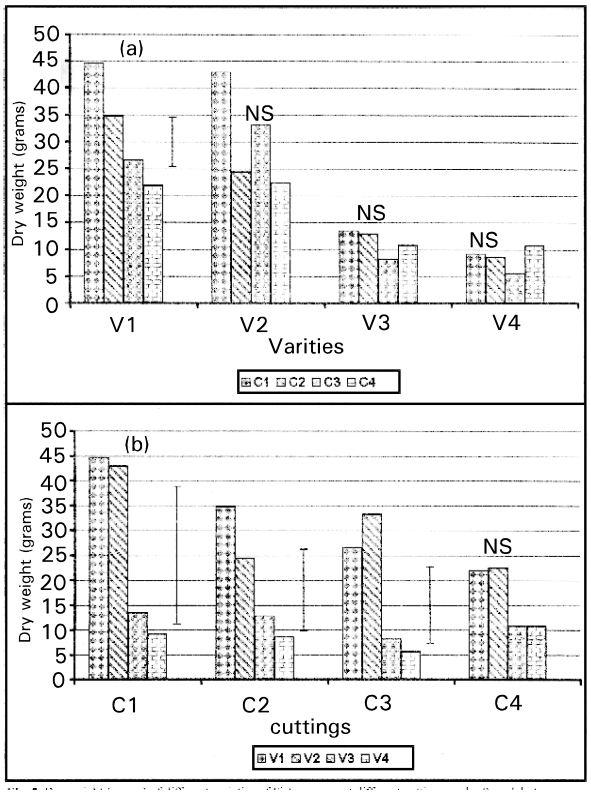

Fig. 2(a-b): Dry weight (grams) of different varieties of Fistuca grass at different cuttings under Rawalakot. (a) LSD indicates least significant difference ($p<0.05$) of different cuttings within individual variety (b) indicates least significant difference ($p<0.05$) among different varieties

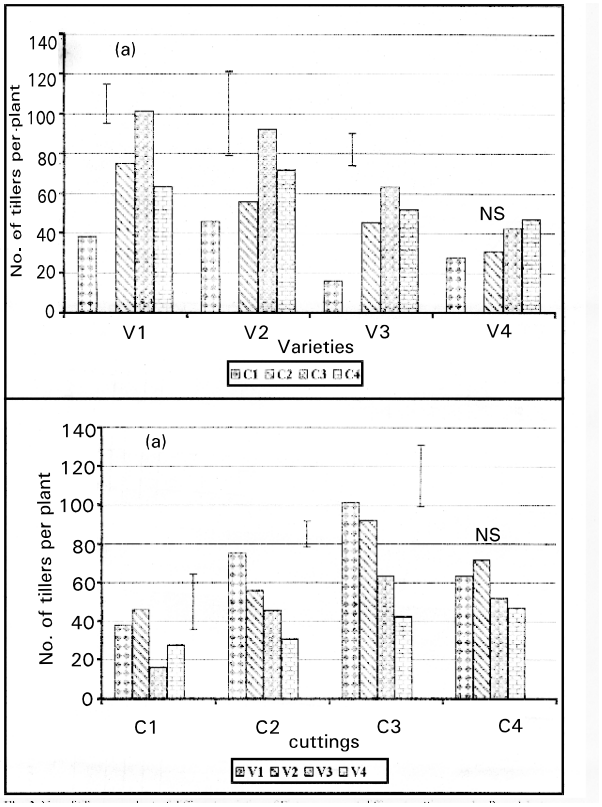

Fig. 3(a-b): No. of tillers per plant of different varieites of Fistuca grass at different cuttings under Rawalakot. (a) LSD indicates least significant difference ($p<0.05$) of different cuttings within individual variety (b) indicates least significant difference ($p<0.05$) among different varieties

(Fig. 2a, b). The dry matter yield between four cuttings showed significant difference in case of UCR4 (V1) but it was non significant in case of UCR3, UCR2 and UCR1 (Fig. 3a). Whereas the same values when compared among the varieties the significant differences was found from 1st to third cuttings except in 4th cutting which was non significant (Fig. 2b). The continuous declining trend in dry matter yield in progressing cuttings in *F. arundinaceae* (V1), from 1st to 3rd cuttings in . *F. pratensis* and *F. rubra* has been recorded (Stahlin and Daniel, 1965; Hunt, 1961), whereas the 4th cutting in the later species deviated in this respect (Nordestgaard, 1986). The general comparison will show that the two varieties of *F. arundinaceae* (V1 and V2) perform better than the varieties of *F. pratensis* and *F. rubra* (V3 and V4) in tillering capacities as well as in fresh and dry matter yield. However, the growth of *F. pratensis* and *F. rubra* was steady and was little affected by the monsoon season. All species gave good persistence and adaptation under Rawalakot conditions and showed their suitability for longer grazing season as well as for the control of soil erosion in hilly areas of Pakistan (Ahmad and Chaudhry, 1995; Mahmood *et al*., 1997). The species are in the field for the last 7 years and are producing good herbage and soil cover (un-published data) since their establishment in 1993. The species do have their value in future breeding programme in combination with local species as their universal potential is well established (Jouhar, 1987).

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