Integration of Fodder Legumes into Rice-based Cropping Systems in Bangladesh: Production of Lathyrus Sativus and Its Use as a Supplement to Straw-based Rations of Dairy Cows

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ABSTRACT: Production of the fodder legume, Lathyrus sativus, was studied in the rice fields of farmers to mitigate a shortage of fodder supply to dairy cattle and to improve soil fertility. Eight farmers broadcast seed of the fodder legume as a relay crop in standing Aman rice. Fodder yield was recorded and soil fertility was assessed. Fodder was harvested after 2 months and fed to milking cows by mixing with straw. Average green yield of fodder was 11.02 t/ha and soil OM and nitrogen were increased as a result of legume growth. Milk yield was increased by 20% and 14% in on-farm and research station studies respectively, and milk composition slightly increased due to the supplementation of straw with fodder. It may be concluded that the integration of a fodder legume into a rice-based cropping system is a practical solution to fodder shortage and that it restores soil fertility and improves milk yield and milk composition of dairy cows.

Key Words: Bangladesh, Fodder legumes, Rice Strw, Supplements, Dairy Cows

INTRODUCTION

In Bangladesh, farmers can not allocate land exclusively for fodder production because of its high demand for human food production. The situation has resulted in an alarming shortage of green fodder for dairy cattle; rice straw has become almost the sole roughage for these animals. This poor quality roughage limits the full production potential of the animals. A preliminary study has shown that the small holder farmers are interested in growing fodder to feed their cattle if the technology is available, even if it means some change in their cropping patterns (Akbar et al., 1996). The intensive cropping system followed by the farmers not only results in a shortage of green fodder but also depletes the soil fertility. In rural Bangladesh livestock are kept in small holder mixed crop/livestock farming systems. There is scope to integrate fodder production into the existing cropping system followed by farmers (Akbar et al., 1996). The benefits of integrating leguminous fodders into non-leguminous food cropping systems have been elucidated by a number of researchers. Haque (1992) stated that in crop/livestock production systems, legumes can be integrated with crops to improve soil fertility and soil structure, thus enhancing crop yields and providing high quality feed for livestock. Rahman (1994) reported that both legume and non-legume fodder might be integrated with a rice-based cropping system.

Studies examined the feasibility of introducing fodder legumes into a rice-based cropping system in order to alleviate the shortage of green fodder for dairy cattle, to restore the soil nutrient status of the cropping land and to determine the effect of feeding this fodder as a supplement to a straw-based ration for dairy cattle.

MATERIALS AND METHODS

Eight farmers having between 1.02 to 3.04 hectares of land and 3 to 4 cattle were chosen randomly from two villages namely Rajpur and Garaikuti under a Thana (a small administrative unit) called Muktagacha in Mymensingh district. Seed of Lathyrus sativus, a fodder legume, was sown at 100 kg/ha by the farmers as a relay crop in standing Aman rice (dry season rice) in the month of October.

Data on plant height, number of branches per plant and green weight were taken during harvesting in January. Green biomass yield was determined by harvesting green plants from a 1 m² area at five locations in each plot. Soil samples were collected from each plot before and after fodder cultivation and analysed for organic matter and nitrogen content following the methods described by Page et al., (1982). Top portions of Lathyrus fodder were collected and sun dried to make hay in order to feed them to the dairy cattle for the animal experiment and the remainder of the Lathyrus fodder was incorporated in the soil.

Thirteen lactating dairy cows of eight farmers were fed on chopped straw diet supplemented with Lathyrus hay at 1.0 kg/d. The study was conducted for 28 days. Milk yield of the cows was recorded daily. Milk yield of these cows were also recorded daily for 28 days before the commencement of the supplementation in order to consider it as yield without supplementation for comparison with supplemented yield. The conditions before and after supplementation remained the same. The data for milk production were analysed following paired T-test.

A parallel feeding experiment was conducted at the Department of Animal Nutrition Research Station, Bangladesh Agricultural University, Mymensingh for a period of 90 days with 6 lactating indigenous cows of the same age and lactation stage. They were allocated into two groups (A & B), each having 3 cows of 146 kg average live weight. Two straw-based rations, containing rice straw, wheat bran and oil cake but differing in the roughage content, green grass (ration A) or Lathyrus hay (ration B), were supplied to the two groups of cows in a random manner. The design of the experiment followed was Completely Randomised Design (CRD). Daily feed intake was recorded and total collection of faeces was done to determine the
digestibility of feeds. Milk yield was recorded daily and the weekly milk samples were analysed in the laboratory for fat, protein, total solids and serum solid contents. The data of this experiment were analysed following paired T-test for significant differences among the mean values.

RESULTS

Fodder production and soil nutrient status

Plant height varied from 39.5 cm to 46.6 cm (average 42.7 cm), the average number of branches per plant was 7.7 and the mean green biomass yield of the fodder was 11.3 t/ha. The average values for organic matter and nitrogen content of the soil before sowing the legume were 1.57% and 0.092% and those after cultivation were 1.74% and 0.1%, respectively. The use of the legume fodder significantly (P<0.01) improved both attributes.

Animal Feeding Trial

On-farm trial: Milk production of animals in the onfarm study was significantly (P<0.01) increased due to supplementation of straw diet with Lathyrus fodder. Milk yield of supplemented cows (2.5 kg/d) increased by 20% compared with the unsupplemented cows (2.1 kg/d).

On-station trial: Dry matter intake by the animals fed different rations did not differ significantly; however, digestible organic matter intake significantly (P<0.05) increased due to Lathyrus supplementation (Table 1). Organic matter (OM), crude protein (CP) and neutral detergent fibre (NDF) digestibility were significantly (P<0.01) increased due to Lathyrus supplementation. Digestible crude protein and total digestible nutrients also significantly (P<0.01, P<0.05, respectively) increased due to supplementation of Lathyrus fodder.

Supplementation of Lathyrus hay with straw-based diet resulted in significantly (P<0.05) increased (~14%) milk yield of the cows compared with those fed the unsupplemented diet. There was no significant (P>0.05) increase in total solids, fat, serum solids or protein content of milk produced by the cows fed on Lathyrus supplemented diets compared with those on the unsupplemented diets.

DISCUSSION

The average plant height and the branching number indicate that Lathyrus fodder grew reasonably well. The mean green biomass yield of the fodder is comparable with that reported by Rahman (1994) under his on-station study. This indicated that farmers were able to achieve similar levels of production of legume fodder to that achieved on a research station.

Increase in the OM and nitrogen content of the soil due to cultivation of Lathyrus fodder indicates that the residual material of the fodder after harvesting for animal feeding, along with rice crop residues, contributed to the elevated OM and nitrogen content of the soil. Incorporation of leguminous forages in the soil has been reported to increase soil fertility in terms of OM and nitrogen (Haque, 1992; Islam et al., 1999).

The significantly increased milk production of cows under on-farm study conditions compared with those not fed Lathyrus fodder clearly indicates the importance of the supplementation of rice straw diet with legume fodder for improving milk production of indigenous cows. The reason for increased milk production with Lathyrus feeding might have been due to high protein and micronutrient content in leguminous fodder (Akbar et al., 1993).

The significant increase in the digestibility of OM, CP and NDF in the animals of the fodder-supplemented group indicated that the supplementation of Lathyrus fodder maintained the favourable environment for enhanced microbial fermentation in the rumen. Nielson (1981) claimed that untreated straw could be digested to a greater extent if animals were fed a good quality forage.

Under research station study, significantly (P<0.01) increased milk production in the cows fed a Lathyrus fodder supplemented ration over that of animals on a control ration might be due to the similar reasons stated above for the on-farm study. The evidence suggests that when straw was the basic diet supplementation with good quality forage and bypass meals stimulated animal performance (Preston, 1986). The non-significant increase in milk composition from fodder supplementation is supported by the findings of Khan et al., (1991) who found that the supplementation of straw diet with Leucaena fodder non-significantly increased milk composition.
Table 1. Feed intake, nutrient digestibility, nutritive values, yield and composition of milk of cows fed on rations supplemented without or with *Lathyrus sativus* fodder

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Groups of animals</th>
<th>SED</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Dry mater intake (kg/d)</td>
<td>5.06</td>
<td>4.97</td>
<td>0.017</td>
</tr>
<tr>
<td>Dry mater intake (g/kg \textsuperscript{0.75}/d)</td>
<td>120.55</td>
<td>118.98</td>
<td>0.400</td>
</tr>
<tr>
<td>Digestible OM intake (kg/d)</td>
<td>2.82</td>
<td>2.99</td>
<td>0.020</td>
</tr>
<tr>
<td>Organic matter digestibility (%)</td>
<td>63.75</td>
<td>68.46</td>
<td>0.250</td>
</tr>
<tr>
<td>Crude protein digestibility (%)</td>
<td>65.53</td>
<td>76.12</td>
<td>0.320</td>
</tr>
<tr>
<td>Neutral detergent fibre digestibility (%)</td>
<td>67.27</td>
<td>74.47</td>
<td>0.040</td>
</tr>
<tr>
<td>Digestible crude protein (%)</td>
<td>6.87</td>
<td>9.50</td>
<td>0.050</td>
</tr>
<tr>
<td>Total digestible nutrients (%)</td>
<td>60.49</td>
<td>64.93</td>
<td>0.410</td>
</tr>
<tr>
<td>Metabolisable energy (MJ/kg DM)</td>
<td>8.93</td>
<td>9.61</td>
<td>0.040</td>
</tr>
<tr>
<td>Milk yield (kg/d)</td>
<td>1.34</td>
<td>1.53</td>
<td>0.020</td>
</tr>
<tr>
<td>Total solids (%)</td>
<td>12.51</td>
<td>14.17</td>
<td>0.850</td>
</tr>
<tr>
<td>Milk fat (%)</td>
<td>3.80</td>
<td>4.55</td>
<td>0.510</td>
</tr>
<tr>
<td>Serum solids (%)</td>
<td>8.71</td>
<td>9.62</td>
<td>0.350</td>
</tr>
<tr>
<td>Milk protein (%)</td>
<td>4.80</td>
<td>5.03</td>
<td>0.310</td>
</tr>
</tbody>
</table>

Animals group A was fed diet without supplementation and group B was fed fodder supplemented diet. and ** denote significant at 5% and 1%, respectively while NS denotes non-significant at 5% level.

**CONCLUSION**

Production of the legume fodder, *Lathyrus sativus*, may well be possible as a relay crop with Aman rice. The time period before the next Boro rice is sufficient to yield a considerable amount of fodder without altering the food-cropping pattern of rural farmers. Cultivation of *Lathyrus* fodder in between the two crops increased the nitrogen and organic matter status of the soil. Supplementation of straw-based diets with *Lathyrus* fodder significantly improved milk yield of lactating cows. It also tended to increase milk composition.

**REFERENCES**


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