Research Article

Effect of Common Vetch *(Vicia sativa L)* Legume on Growth and Yield of Rye Grass *(Lolium multiflorium L)*

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Abstract | This study has summarized research and field observations of the work that was conducted from 2015 to 2016 at field area of the Range Land Research Institute (RRI), National Agriculture Research Centre(NARC), Islamabad to evaluate the effect of Common Vetch (*Vicia sativa L.*) legume on growth and yield of Rye grass (*Lolium multiflorium L*). Data regarding the physical-chemical analysis of the soil (ph, electrical conductivity, total nitrogen, organic matter and available phosphorus), crop parameter (Number of tillers, number of leaves, plant height, fresh land dry weight and crude protein) and meteorological data regarding rain fall, temperature, pan evaporation, sunshine and wind speed for interpreting results along with their statistical analysis as fixing legume with grass has improved the forage quality. Overall, these results has suggested that grass-legume mixtures can improve livestock and pasture productivity, sustainability and as well as to fix atmospheric nitrogen and this may improve soil N status also. These mixtures were also recommended for use in the semi-arid region of Pakistan as it would be beneficial economically.

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Introduction

Rawalpindi, Attock, Chakwal and Jehlum regions are dispersed in more than one and a half million hectares that are located in or being comprised by Pothwar region. Being a part of rain-fed zone, its narrative considerably up to reasonable extent both in livestock and as well as agriculture sector. Nothing can be predicted about rainfall and it changes abruptly from 250mm in south-west zone to 1000mm in north-east zone. This territory or location lies at 74º.00 E (East) and 32ºN (North). Pothwar region is categorized as both in sub-humid and sub-tropical zones of Pakistan. Approximately even higher than 70 percent of precipitation falls during the monsoon era where as there is reasonable common shortage of forage for livestock during the months of winter and spring seasons (Qamar and Arshad et al., 2002). In Pothwar region, where areas are being rain-fed and have the problem of low soil fertility, during the season of cool winter mainly due to relation to OM, farmers are using mustard and wheat as green fodder while during the hot summer days sorghum/ maize or millet are being used. Above mentioned crops are grown widely throughout the country but they are frequently destroying the essential nutrition components in the soil. Inorganic nitrogenous fertilizers are highly limited in rain-fed areas due to

shortage of rain for growing cropping pattern that's why there is essential requirement to incorporate legume-cereals for fodder production so that yield increases on reasonable basis (Parveen et al., 2001).

Pakistan economy is raising and policy is being made for livestock production which plays an important role in the development of agriculture sector. Those areas where agriculture production is mostly fed through rain, their livestock plays an essential role. Some decades before, there were low amount of legumes to be deliberated in growing methods for both livestock and soil prosperity, most often in cold season of winter and in rain relaying regions. Livestock sector cooperates to about 56.7 % in the profit of agriculture while gross domestic product GDP is approximately 12.5 % (Anon, 2011). In rainfall relaying regions, the yield of fodder is being decreased by less supply of moisture, low fertility status of soil and old growing or cultivating methods (Khan et al., 2012). Nutritional features relating to protein are less in proportion to serve the animal; that's why fodder is enriched with leguminous contents in animal diet menu (Osman and Osman, 1982). Combination of legume vegetation and grasses should enhance the growth and quality of fodder in terms of crude protein substance, voluntary intake and digestibility (Tukel and Yilmaz, 1987). Output relating evergreen vegetation have showed 60 to 80% increase during summer making forage available during winter era when the availability of forage will be low (Jung et al., 1978). Evergreen grasses, e.g. Caucasian bluestem (*Bothriochloa caucasia C.E. Hubbard*) and Rye grass (*Lolium multiflorium L.*) has proved their constant production where the soil surface is not shallow to permit them to the rooting prospect, making them enriched with nutrition. Therefore, hot and humid evergreen grassy vegetation have high nutrition so they are cultivated to enhance rates of milk and meat. Mixing leguminous species should enhance the forage value of evergreen grassy vegetation. *Lolium multiflorium L.* is an evergreen grass located in even surface areas and as well as up to 1000 m in subtropical and tropical zone. Certain types of vegetations are beneficial as they establish quickly and give more productivity and nice palatability as well as capability to stand fast in horrible eras of overgrazing. Pure stand of certain vegetation are reseeded after half decade during horrible environment (Grazing pressure and drought) (Brown et al., 1966). Leguminous crops are suggested as important component for sustainable system of animal production and yield. During the last few years, the importance of legumes has increased due to the characteristic of nitrogen fixation by nature (Porqueddu and Sulas, 1998). *Lolium multiflorium* L. by nature is regenerating specie by its own self, modifies itself mostly in sub acid-alkaline soil. Someone can characterize it by reliable fodder specie during cold and spring season (Sitzia et al., 2000). In semiarid grazing meadows, within year legumes that regenerate themselves have an important role due to their fodder value and nitrogen fixation capability and as well as in symbiosis with root-nodule bacteria, rising soil richness and supporting the nutritional values of other plants.

Goals and as well as intentions of exploration was:

- To evaluate the increase in growth and yield of Rye grass (*Lolium mulltiflorium L*) with respect to Common Vetch (*Vicia Sativa L*) legume.
- To evaluate the concentration of crude protein in the *Lolium multiflorium L* to estimate forage quality in mixture.
- To evaluate the impact of Rye grass (*Lolium multiflorium L*) and Common Vetch (*Vicia Sativa L*) mixture on soil fertility status.

Materials and Methods

Study area

The prospective research was done in Rangeland Research Institute (RRI) field area located in National Agriculture Research Centre (NARC) situated in capital region of Islamabad, Pakistan from session of 2015-16, which comes in territory of both sub-tropical and sub-humid zones of Pothwar plateau. The rainfall lies in range approximately up to 946 mm which is being recorded since last century (Jilani et al., 2011). Climate conditions vary from season to season because of hot and humid conditions. Even rise in temperature during June is up to 45°C while in cold winter season, intense frost is being observed during month of January.

Methodology

Plot dimensions and designs: The overall design stature was 14m×36m= 504 square meter; while small block size was 3.5m×6m= 21 square meter. 15 plots and 3 replications were made and gap between two blocks was 1.5 m for making a walking pathway and as well as avoiding nutritional competitions among species. Plot design chosen was totally Random Complete

Block Design (RCBD) having five treatments and three replications of each block and cultivations was done in the following manner:

1. Common Vetch (alone) T1
2. Rye grass (alone) T2
3. Common Vetch 75% + Rye grass 25% T3
4. Common Vetch 50%+Rye grass 50% T4
5. Common Vetch 25%+Rye grass 75% T5

Physical-Chemical soil analyses.

Soil sampling: Different proportions of soil sample were taken at the depth of (20-40cm) from study site before sowing and after harvesting of the vegetation to evaluate the impact of legume on soil fertility.

Soil analyses: Soil was being analyzed for soil texture, pH level, EC, available phosphorus, soil organic matter and total nitrogen through following tests:

Soil texture: ISSS (International Soil Science Society) triangle was being operated to determine soil textural classification (Gee and Bauder, 1986).

pH level: pH meter was being adopted to measure soil pH (Page et al., 1982).

Electrical conductivity: EC meter was used for calculating electrical conductivity in dS/m (Page et al., 1982).

Available phosphorus: Spectrometer was used to measure Phosphorus by 0.5 M NaHCO3 (pH 7.5) of soil (Olsen and Summers, 1982).

Soil organic matter: First of all, equipment named Erlenmeyer flask up to 600 ml; few grams of soil were added to (10ml) potassium dichromate (1N). After that highly concentrated Sulphuhric acid (20ml) was mixed slowly for one minute, stand this solution for half an hour and after this, it was being diluted by de ionized water (175ml) and then di-hydrogen phosphate (10ml); and then an indicator $(C_6H_5)_2NH$ (up to 15-25 drops) was added, then titration was done till sharp green end color was obtained with 0.5N FeSO4·H2O (Olson and sommers, 1982).

Total nitrogen: A soil portion of 15gm with Thirty milliliters of highly concentrated Sulphuric acid and a digesting composition of ten gram was taken to soil portion and heated in a flask named Kjeldahl, till became clear, then for few hours solution was boiled. After digestion, it was cooled by distilled water. By usage of sodium hydroxide and boric acid distillation was done and followed by titration against 0.1N Sulphuric acid and NH4 to evaluate distillate among solution was operated (Hussain and Jabbar, 1985).

Agronomic data

Sowing time: The appropriate time for sowing Common vetch legume was end of November, 2015 and for Rye grass it was during the start of month of December, 2015.

Sowing method: The legume i.e. Common Vetch (*Vicia sativa L.*) was sown by hand sowing with hand drill in combination with each other, respectively. The grass was tufted in that plot and 12 numbers of the tufts was maintained in each plot at field area of range research institute.

Seed rate: Seed rate of both legume and grass; was 100kg/acre. Legume was thoroughly mixed in respective portion.

Weeding: Fourth, eighth and Twelfth week was selected for weeding after planting.

Growth assessment: Parameters that being used to evaluate increase in the growth of grass and legume are enlisted below.

1. Number of tillers
2. Number of leaves
3. Plant height

Harvesting time: Both Common Vetch (*Vicia sativa L*) and Rye grass (*Lolium multiflorium L*) was harvested at the end of month of May.

Yield assessment: Following parameters were recorded to determine increase in the yield of grass.

Green forage yield: Weight relating green fodder was evaluated by using digital balance after harvesting approximately up to 2cm above from the ground surface to obtain both fresh and dry forage weights to measure the yield increment of grass.

Dry matter yield: After measuring fresh weight for 48 hours the green forage was oven dried for 2 days duration at temperature of 70°C to obtain dry matter yield.

Table 1: *Research plotting at experimental site.*

	R1	R2	R3
T1	Rye grass 100% 8 Lines	Ryegrass 75% 6 Lines Common Vetch 25% 2 Lines	Rye grass 50% 4 Lines Common Vetch 50% 4 Lines
T2	Rye grass 25% 2 Lines Common Vetch 75% 6 lines	Common Vetch 100% 8 Lines	Rye grass 100% 8 Lines
T3	Rye grass 50% 4 Lines Common Vetch50% 4 Lines	Rye grass 25% 2 Lines Common Vetch 75% 6 lines	Ryegrass 75% 6 Lines Common Vetch 25% 2 Lines
T4	Ryegrass 75% 6 Lines Common Vetch 25% 2 Lines	Rye grass 100% 8 Lines	Rye grass 25% Lines Common Vetch 75% 6 Lines
T5	Common Vetch 100% 8 Lines	Rye grass 50% 4 Lines Common Vetch 50% 4 Lines	Common Vetch 100% 8 Lines

Crude protein analysis: Micro-Kjeldahl method was being used to measure crude protein contents (AOAC, 1994) at NARC; Islamabad, Pakistan.

Meteorological data: Data related to atmosphere aspects such as rainfall, temperature, pan evaporation, sun shine and wind speed for descriptions of results being obtained from Department of Climatic Change, Alternative Energy and Water Resources Institute, NARC.

Statistical analysis: Variance (ANOVA) technique under randomized complete block design (RCBD) was used for analysis of statistical data using Statistix 8.1 software. The treatment means was compared by LSD at 5% level of probability for multiple comparisons (Steel and Torrie, 1997).

Results and Discussion

Prospective analysis work was done during the session of 2015-2016 in Range Land Research Institute (RRI) locality zone, located in National Agricultural Research Centre (NARC), Islamabad, Pakistan to determine the "Effect of Common Vetch (Vicia Sativa L) on growth and yield of Rye Grass (Lolium multiflorium L)". Data related to physical and chemical features of soil surface i.e. ph, electrical conductivity, total nitrogen, organic matter and available phosphorus, measuring components related to growth and yield assessments i.e. Number of tillers, number of leaves, plant height, fresh land dry weight and crude protein and climate components related to rain fall, temperature, pan evaporation, sunshine and wind speed for interpreting results along with their statistical analysis show that fixing legume with grass had improved the forage quality. Overall, these results have suggested that grass-legume mixtures can improve livestock and pasture productivity, sustainability and as well as fix atmospheric nitrogen and this may also improve soil N status. These mixtures are also recommended for use in the semi-arid region of Pakistan would be beneficial economically.

Physical-chemical soil analysis of soil

Measurements with respect to physical and chemical composition of soil before sowing and after cutting were interlinked in following (Tables 1 and 2). After the harvest of each plot in experimental site; it was observed that plot where legume Common Vetch (Vicia *Sativa*) was more in proportion as compare to Rye grass (*Lolium multiflorium* L) produced more amount of organic matter. It is being observed that presence of phosphorus among plots was higher in concentration where Common Vetch (Vicia sativa) was more in proportion; and it was lesser in concentration in monoculture of grassy vegetation but EC and pH observance was contrary to lateral. The portions of roots and green vegetation related to legumes can be faithful for nitrogen fixation in to the soil surface which is beneficial to competing crop stands. The advantage of nitrogen fixation happens mostly due to formation of nodules which behave as a main source of nitrogen to the comparison crop (Adu-Gyamfi et al., 2007). Concentration of organic contents present in soil increases due to intercropping pattern of both grass and leguminous vegetation and same result is being observed in nitrogen fixation (Rahman et al., 2009). Enhancement of upper ground output by the roots of leguminous vegetation in mixture may cause minerals of soil accessible. Nutrients transportation such as P might occur due to the linkage of mycorrhiza (Newman, 1988). Hence after whole discussion we come to a point that leguminous vegetation plays a key role in increment of soil fertility status to overcome shortage of soil

nutrients through biological nitrogen fixation of atmospheric nitrogen and as well as proved themselves to have yield factor with intercropped crops than as compare to monoculture or pure stand. As related to economical status of certain crops sowing practices are easy to use and lighter in expenditure and anyone, anytime and anywhere can adopt this intercropping technology with low amount of expenses.

Table 2: *Physical and chemical soil status before sowing and after harvesting.*

Sr. No	Characteristics	Values
1	Sand	35.45%
2	Silt	31.81%
3	Clay	33.61%
4	Texture	Loamy soil
5	OM	.89%
6	EC	.23ds/m
7	pH	7.71%
8	Total Nitrogen	.041%
9	Phosphorus	5.44ppm
Sr. No	**Characteristics**	**Values**
1	Sand	35.45%
2	Silt	31.81%
3	Clay	33.61%
4	Texture	Loamy soil
5	OM	.93%
6	EC	.21ds/m
7	pH	7.67%
8	Total Nitrogen	.051%
9	Phosphorus	5.49ppm

Lolium multiflorium L is well dispersed in Mediterranean region of Southern Europe, North Africa and Asia. Now it is grown in all parts of the world. The grass is adapted to wide range of soils but grows best on soil of medium to high fertility. The Present study was conducted in field areas of range land research Institute (RRI), National Agricultural Research Centre (NARC) to evaluate the "Effect of Common Vetch (Vicia sativa L) on growth and yield of Rye grass (Lolium multiflorium L)". The experiment was laid out in RRI nursery; by introducing five treatments with three replications which made 15 blocks in RCBD layout as illustrated in methodology. Overall, results of researchers reviewed in this study, showed that grass-legume intercropping can be used as a sub stile management in strategy for high quality and quantity of forage. The blocks in experimental zone where the mixture of grass and legumes together produced higher growth and yield that that of monoculture or pure stand due to increment of CP concentration of fodder and soil fertility status through biological nitrogen fixation of leguminous vegetation as compare to grass monocultures. It should be due to the aspect of better nutrient usage, atmospheric N and water utilization by grass when being intercropped with legumes

The proposed study has proved that growing Rye grass with Common Vetch legume resulted positive effects because the combination of both these produced more green and forage production output than that of monoculture. It is clear from observation that positive effects were present in mixture blocks and Rye grass produced higher biomass as associated with legumes than sole cropping system. Across all experiment we can say that legume effects were strong enough to result in increased growth and crude protein. Mixing legume with grass has also improved the forage quality. Overall these results have shown that grass-legume mixture can improve the livestock and pasture productivity and sustainability.

Conclusions and Recommendations

Finally, it is concluded that leguminous vegetation plays a key role in increment of soil fertility status to overcome shortage of soil nutrients through nitrogen fixation of atmospheric nitrogen and as well as proved themselves to be a yield factor with intercropped crops than as compare to monoculture or pure stand. As related to economic status of certain crops, sowing practices are easy to use and lighter in expenditure and anyone, anytime and anywhere this intercropping technology within low amount of expenses. So, intercropping of compatible legumes with grass is recommended because these not only improve the forage quality of grass, but also fix the atmospheric nitrogen and this may improve soil N status may also.

Author's Contribution

Aamir Saleem: Conceived the idea, Conclusion, Data collection, Data entry in SPSS and analysis, Result and discussion, introduction, References.
Arshad Mahmood Malik: Technical input at every step, Overall management of the article, Did SPSS analyis, Result.
Najam Ul Hassan: Wrote abstract, Methodology,

Conclusion, Data collection, Data entry in SPSS and analysis, Result and discussion, introduction, References.

Imtiaz A. Qamar: Technical input at every step, Overall management of the article.

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