Pak. j. life soc. sci. (2008), 6(2): 135-139

Pakistan Journal of
Life and Social Sciences

Effect of Seed Proportion and Nitrogen Application on Forage Yield and Nutritive Value of Barley-pea Mixture Harvested at Different Times

Muhammad Ayub, Asif Tanveer, Muhammad Athar Nadeem, Muhammad Tahir and Muhammad Ibrahim
Department of Agronomy, University of Agriculture, Faisalabad, Pakistan.

Abstract

Response of barley-pea mixtures when sown at seed proportion of 100:0, 75:25 and 50:50 to nitrogen levels viz., 0 and 50 kg ha^{-1} and harvesting times of 57, 75 and 92 days after sowing was studied at the University College Farm, Aber, gwynedd, UK. Dry matter percentage, dry matter yield and protein yield were consistently increased up to the final harvest. Whereas, a significant decrease in fresh and digestible dry matter yield was observed at the third harvest. Digestible dry matter percentage was decreased significantly with delaying the harvest. The effect of harvesting time on crude protein and modified acid detergent fibre was not significant. The barley-pea seed proportion of 50:50 produced significantly higher forage, dry matter, protein and digestible dry matter yields over seed ratio of 100:0 and 75:25. Dry matter and modified acid detergent fibre percentages were decreased, whereas, crude protein and digestible dry matter percentage were increased with the addition of pea in the mixture. The application of 50 kg N ha^{-1} increased the yields and dry matter percentage. The quality parameters like crude protein, modified acid detergent fibre and digestible dry matter percentage were not affected significantly by nitrogen application. The data indicate that crude protein concentration and yield, digestible dry matter yield and digestible dry matter percentage can be increased by growing barley with pea at seed proportion of 50:50 and applying nitrogen at the rate of 50 kg ha^{-1}. The best time for harvest keeping in view both quality and yield was 75 days after sowing.

Key words: Nitrogen, forage yield, nutritive value, seed proportion, Harvesting in tervals.

Introduction

Barley forage can be used for direct grazing, cutting and feeding to animals or for conservation by drying or ensilage. In arid and semi arid regions, cattle survive principally on cereal straw. Cereal forage and grain are considered to be poor in protein and essential amino acids (Cherneyand and Marten, 1982). Mixed cropping especially with legumes can improve the forage quality and yield (Ahmad *et al.*, 2007 and Shoaib, 2008). Originally, growing of crops in mixture was considered beneficial to low level of inputs and technology but now it is considered to be advantageous at medium to high levels of technology (Lakhani, 1976). The intercropping oat with pea increased yield of haylage (Robinson, 1960) and crude protein concentration (Carr *et al.*, 1998). According to Chapko *et al.* (1991) intercropping pea with barley increased dry matter production.

The proportion of component crops in mixture is an important factor determining yield, quality and production efficiency of a cereal legume mixture (Lakhani, 1976). The higher proportion of legumes in mixture reduced yield (Ayub *et al.*, 2004). Izaurralde (1990) reported that no yield advantage results when barley and pea were intercropped at a sole crop rate compared with lower rates in barley-pea mixtures. Nitrogen yield was increased by intercropping when both barley and pea were sown at more than half the sole crop seed rate. The total exclusion or their inclusion at very low sowing rates produced nutritionally inferior forage. Therefore, a correct balance of legume-non-legume in mixture is very important.

Among the agronomic factors that may affect the yield and quality of forage in cereal legume mixture, the application of nitrogen is considered to be the most important (Tofinga, 1990). It increased yield and protein contents of mixed forage (Iqbal *et al*, 2006). The effect of fertilization vary with soil type, ratio of available nutrients, fertility with in soil type, crops and climatic conditions (Ward, 1959). The growth of legumes and nitrogen fixation is often increased by the application of small amount of nitrogen (Diatloff, 1974). Higher rates of nitrogen application reduce the number of effective nodules, increase the risk of lodging and encourage diseases (Nannetti *et al.*, 1990). It can also depress the growth of cereals and legumes (Liebman, 1989). Therefore to obtain higher yields from a mixture containing a legume component, it is vitally important that

Corresponding author: Muhammad Ayub
Department of Agronomy, University of Agriculture, Faisalabad, Pakistan.
Email: mayubuaf@hotmail.com

recommendation for fertilizer should be as precise as possible to ensure an efficient utilization of the nutrients.
Therefore, this research was conducted to determine how forage yield and quality of barley-pea mixture harvested at different times are influenced by seed rates of component crops and nitrogen levels.

Materials and Methods
The pot experiment was conducted at University College Farm, Aber gwynedd, United Kingdom in the green house with no temperature control and with out artificial heating. The experiment was sown in 23 cm x 23 cm pots painted black on their outer sides. The container had a hole drilled at the bottom for drainage. The growing medium was sand and soil in proportion of 1:1 by weight. The soil used (after mixing with sand) was analyzed and it was having 5.9 pH, 0.5% N, 72 ppm P, 172 ppm K and 10.23% organic matter. Barley variety Atem and pea variety Triffed were sown in the seed proportion of 100:0 (S1), 75:25 (S2) and 50:50 (S3) on 12th November and terminated on 5th June. The treatments were sown at seed rate of 180 kg ha^{-1}. Having determined average seed weight, 20 barley, 16 barley + 1 pea, 12 barley + 2 pea seeds were required for S1, S2 and S3, respectively. Seeds of barley were sown at the depth of 4 cm and those of peas were sown at 6cm. Two seeds per site were sown and thinned, where necessary, to one per site after germination. The experiment was arranged as a randomized complete design with three replications. The pots were arranged on bench and each bench was considered as one replication. The nitrogen fertilizer at the rate of 0 and 50 kg ha^{-1} was applied to the appropriate pots on 5th December, phosphorus and potash fertilizer were applied to all pots at sowing. One plot per treatment per replication was harvested at each harvest. The samples were dried at 80^{o}C until a constant weight was attained. Plant samples were analyzed for total nitrogen using Kjeldhal method (AOAC, 1984) with a Kjeltec Auto 1030 Analyzer. The samples were digested using block digester-Tecam DG-1. Modifed acid detergent fibre percent was determined using fibretec system M-Tecator consisting of a hot extractor (1020) and cold (1021) extractor (AOAC, 1984). Digestible dry matter percentage (DDM%) was determined by incubation in faecal liquor described by Omed *et al*. (1989). The data collected from experiment was subjected to statistical analysis using Fisher's analysis of variance technique and the treatment means were compared by using LSD test at 5 per cent probability level (Steel *et al*., 1984).

Results and Discussion
The treatments containing barley and peas produced significantly higher forage yield than barley alone. The yields were increased with increase in pea seed rate. Higher forage yield from cereal legume mixture have also been reported by Ayub *et al*., (2004), Iqbal *et al*. (2006) and Ahmad *et al*. (2007). One possible explanation of this is the ability of component crops to exploit the different soil layers without competing with each other. The nitrogen application at the rate of 50 kg ha^{-1} significantly increased both forage yield and dry matter yield over control. An increase in yield with nitrogen fertilizer has also been reported by Papastylianou (1990) for oat and pea mixture and Shoaib (2008) for sorghum and guar mixture. The results are contrast to those of Odongo *et al*. (1988). They explained this in relation to high residual nitrogen in the soil. Maximum fresh yield was obtained when crop was harvested 75 days after sowing. Dry matter yield was increased significantly as the time before harvest was extended being maximum at final harvest. Increase in dry matter yield with delaying the harvest has been reported previously by Droushiotis (1989) for mixture of oat and triticale with peas and Ayub *et al*. (2003) for fodder maize. Protein yield and digestible dry matter yield was increased as the proportion of pea in the mixture was increased. Barley sown alone produced significantly lower crude protein and digestible dry matter yield than the mixture of barley and pea. These results are in accordance with the findings of Droushiotis (1989) and Hikam *et al*. (1992). The application of 50 kg N ha^{-1} significantly increased both protein and digestible dry matter yield over control. Protein yield was increased up to the final harvest which is in agreement with the results reported by Rumburg and Svena (1970). The digestible dry matter yield was significantly decreased at third harvest. The probable cause of decrease at final harvest might be the combined effect of leaf fall and decrease in digestible dry matter percentage. Dry matter percentage decreased as the proportion of pea in the mixture was increased but it could not reach to the significant level. Lower dry matter percentage in cereal-legume mixture has also been reported by Ayub *et al*. (2004). The results are in contrast to those Gilliland and Johnston (1992). They reported that despite of large differences in the ratio of pea to barley, the dry matter contents were not affected significantly. They attributed these differences to low rainfall causing senesce. Application of 50 kg N ha^{-1} gave higher dry matter percentage than zero kg N ha^{-1} which agrees with the results of Ayub *et al*. (2003). Dry matter percentage was increased as period before harvest extended being maximum at the third harvest which agrees

with the published work of Hadjichristodoulou (1976) for mixture of barley, wheat with vetches and pea and Ayub *et al*. (2003) for fodder maize. The results are contradictory to those of Dirienzo *et al*. (1991). They reported that an increase in nitrogen rate decreased the dry matter percentage of barley forage from 32.3% at 0 kg N ha^{-1} to 29.8% when 133 kg ha^{-1} of nitrogen was applied. They explained that the decrease in dry matter parentage was due to the influence of nitrogen on plant maturity and it has been reported that nitrogen application can delay maturity in barley and oat (Birch and Long, 1990).

Crude protein percentage was increased significantly as the proportion of peas was increased being maximum at barley pea seed rate raio of 50:50. The results are quite in line with those of Ayub *et al*. (2004) and Shoaib (2008). The effect of nitrogen application on crude protein percentage was not significant. The results are contradictory to those of Dirienzo *et al*. (1991). They reported that crude protein contents of barley forage increased as the rate of nitrogen application increased. These contradictory results might have been due to variation in the initial nitrogen status of the soils. Zuber *et al*. (1954) concluded that when soils are deficient in nitrogen, small application of nitrogen will not necessarily increase nitrogen contents. Crude protein percentage was not significantly affected by the harvest date. Non-significant difference between harvest dates, at similar growth stages to the current experiment, has been reported by Henderson and Davies (1955) for oat-pea mixture.

Modified acid detergent fibre percentage was significantly decreased as proportion of pea in the mixture was increased. The results indicated that pea has lower fibre percentage than barley which agrees with the findings of Ayub *et al*. (2004) and shoaib (2008). They reported that legumes (ricebean and guara) was lower in acid detergent fibre than sorghum. The effect of nitrogen on acid detergent fibre percentage was not significant which agree with the published work of Dirienzo *et al*. (1991) for barley.

The mixture of barley + pea gave significantly higher digestible dry matter percentage than barley alone. It increased with increasing proportion of pea which agrees with findings of Droushiotis (1989). The effect of nitrogen on digestibility was non-significant which confirm the findings of Minson *et al*. (1960). They have reported that nitrogen did not affect digestible dry matter percentage. Digestible dry matter percentage was declined with delaying the harvest and decline was significant at each delayed harvest. A similar trend of declining digestibility has also been observed by Rihawi *et al*. (1987) for mixture of barley + pea and barley + vetch; Droushiotis (1989) for oat + pea and triticale + pea. The reason for this decrease can be attributed to change in cell wall content, cell wall poly saccharides composition and variation in morphology.

Conclusion

Keeping in view both quality and quantity the barley-pea mixture sown at seed proportion of 50:50 may be fertilized at 50 kg N ha^{-1} and harvest it 75 days after sowing.

Table: Forage yield and quality of barley-pea mixture as influenced by harvesting times, seed proportion and nitrogen application

Treatments	Forage yield (g pot^{-1})	Dry matter yield (g pot^{-1})	Protein yield (g pot^{-1})	Digestible dry matter yield (g pot^{-1})	Dry matter (%)	Crude protein (%)	Modified acid detergent fibre (%)	Digestible dry matter (%)
Harvesting time (Days after sowing)								
57	2159.6	647.85	43.16	472.73	30.29	6.47	27.90	73.01
75	2651.7	865.64	49.88	600.05	33.03	5.66	27.20	69.24
92	1233..1	908.68	59.53	560.85	73.79	6.35	28.07	61.67
SED	124.44	41.04	4.67	28.22	0.57	NS	NS	0.52
Seed proportion (Barley : pea)								
50:50	2338.0	886.70	70.42	605.53	43.89	7.95	26.86	68.89
75:25	2069.2	833.52	52.17	561.35	45.91	6.29	27.45	67.94
100:0	1637.3	701.95	29.99	466.74	47.30	4.25	28.87	67.10
SED	89.92	42.40	3.12	27.42	0.84	0.23	0.48	0.40
Nitrogen rates (kg ha^{-1})								
0	1794.4	708.30	44.88	479.38	44.84	6.10	28.11	68.17
50	2235.3	906.48	56.84	609.71	46.56	6.23	27.34	67.78
SED	73.42	34.62	2.55	22.38	0.68	NS	NS	NS

References

Ahmad, A.H., Ahmad, R., Mahmood, N. and Tanveer, A. Performance of forage sorghum intercropped with forage legumes under different planting patterns. Pak. J. Bot., 39: 431-439. 2007.

AOAC. Official methods of analysis. Association of Official Analytical Chemists. 14th Ed., Arlington, Virginia, USA., 1984.

Ayub, M., Nadeem, M.A. and Tanveer, A. Influence of different nitrogen levels and harvesting times on dry matter yield and quality of maize fodder. Pak. J. Life Soc. Sci.,. 1: 59-61. 2003.

Ayub, M., Tanveer, A., Nadeem, M.A. and Shah, S.M.A. Studies on the fodder yield and quality of sorghum grown alone and in mixture with rice bean. Pak. J. Life Soc. Sci., 2: 46-48. 2004.

Birch, C.J. and Long, K.E. Effects of nitrogen on the growth, yield and grain protein contents of barley. Aust. J. Exp. Agric., 30: 237-242. 1990.

Carr, P., Glemn, M., Joel, B.M., Caton, S. and Poland, W.W. Forage and nitrogen yield of barley-pea and oat-pea intercrops. Agron. J., 90:79-84. 1998.

Chapko, L.B., Brinkman, M.A. and Albrecht, K.A. Crop breeding, genetics and cytology: Genetic variation for forage yield and quality among grain oat genotypes harvested at early heading. Crop Sci., 31: 874-878. 1991.

Cherney, J.H. and Marten, G.C. Small grain crop forage potential-II. Interrelationship among biological, chemical, morphological and anatomical determinants of quality. Crop Sci., 22: 240-245. 1982.

Diatloff, A. Factors involved in the amelioration of retarded symbiosis in Tinaroo glycine. Aust. J. Agric. Res., 25: 577-581. 1974.

Dirienzo, D.B., Webber, K.E., Brann, D.E. and Alley, M.M. Effect of split nitrogen on barley forage yields and silage fermentation. J. Prod. Agri., 4:39-44. 1991.

Droushiotis, D.N. Mixture of annual legumes and small grain cereal for forage production under low rainfall. J Agric. Sci. Camb., 113: 249-253. 1989.

Gilliland, T.J. and Johnston, J. Barley/Pea mixture as cover crop for rye grass re-seeds. Grass and Forage Sci., 47: 1-7. 1992.

Hadjichristodoulou, A. Effects of harvesting dates on the cereal and legume foage production in low rainfall region. J. Agri. Res. Camb., 86: 155-161. 1976.

Henderson, J.L. and Davis, R.O. The yield and components of mixed cereal legume crops at different stages of growth. The Emp. J. Exp. Agri., 90:130-144. 1955.

Hikam, S.G.G., Ponleit, C.T. and Hilderbrand, D.F. Crop Ecology, Production and management. Intercropping of maize and winged bean. Crop Sci., 32: 195-198. 1992.

Iqbal A., Ayub, M., Zaman, H. and Ahmad, R. Impact of nutrient management and legume association on agro-qualitative traits of legume fodder. Pak. J. Bot., 38: 1079-1084. 2006.

Izaurralde, R. C., Jumma, N.G., and McGill, W. B. Plant and nitrogen yield of barley-field pea intercrop in a cryoboreal-subhumid central Alberta. Agron. J., 82, 295-301. 1990.

Lakhani, D. A. A crop physiology study of mixtures of sunflower and fodder radish. Ph. D. Thesis, Univ. of Reading, U.K., 1976.

Liebman, M. Effects of nitrogen fertilizer, irrigation, and crop genotype on canopy relations and yields of an intercrop/weed mixture. Field Crops Res., 22: 83-100. 1989.

Minson, D.G., Raymond, W.E. and Harris, C.E. Studies on digestibility of herbage. VIII. The digestibility of S37 cockfoot, S32 ryegrass and S24 yegrass. J. Brit. Grass. Soc., 15:174-180. 1960.

Nannetti . S., Carnevalli, G. and Ranieri, R. Rational use of chemical products on barley in the Emilian hills and plains. Informatore Agrariro, 46: 67-69. (Field Crops Absts., 44:6196). 1990.

Odongo, J.C.W., Veresoglou, D.S., Papakosta, D. and Sficas, A.C. Biomass and nitrogen yields of intercropped maize and soybean as affected by applied nitrogen, rhizobium, maize hybrids and population density. J. Agron. and Crop Sci., 160: 30-40. 1988.

Omed, H.M. Asiford, R.F.E., Chamberlain, A.G. and Givens, D.I. Development of a method for in-vitro estimation of digestibility of forage in ruminants. In Phillips C.J. (ed), New techniques in cattle production. Butteworth London, PP:227. 1989.

Papastylianou, I. Response of pure stand and mixtures of cereals and legumes to nitrogen fertilization and residual effect on the subsequent barley. J. Agric. Sci. Camb., 115: 15-22. 1990.

Rihawi, S., Capper, B.S., Qsman, A.E. and Thomson, E.F. Effect of crop maturity, weather condition and cutting height on yield, harvesting losses and nutritive value of cereal-legume mixture grown for hay production. Exp. Agri., 23: 451-459. 1987.

Robinson, R.G. Oat-pea and oat-vetch mixtures for forage or seed. Agron. J., 52: 546-549. 1960.

Rumburg, C.B. and Sneva, F.A.. Accumulation and loss of nitrogen during growth and maturation of cereal rye. Agron. J., 62: 311-316. 1970.

Shoaib M. Study on fodder yield and quality of Sorghum grown alone and in mixture with guar under different planting technique. M. Sc. Thesis Department of Agronomu, Univ. of Agri. Faisalabad, Pakistan, 2008.

Steel, R.G.D. and Torrie, J.H. Principles and procedures of statistics. 2nd Ed. McGraw Hill Book Co., Singapure, pp: 172-177. 1984.

Tofinga, M.P. Studies on mixture of cereals and Pea. Ph.D. Thesis, University of Reading, U.K., 1990.

Ward, G. M. Effects of soil fertility upon the yield and nutritive value of forages. Rev. J. Dairy Sci.,. 42: 277-297. 1959.

Zuber, M.S., Smith G.E. and Gekrke, C.W. Crude Protein of Corn grain and stover as influenced by different hybrids, plant population and nitrogen levels. Agron. J., 46:257-261. 1954.