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Nutritional dynamics in some forage weeds regarding to the phenological stages

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ABSTRACT

Weeds could replace the cultivated fodders in case of fodder shortage. But most of farmers are not aware about the potential of traditional weeds in croplands. Thus, an experiment was conducted to estimate the nutritional quality of some forage weeds with respect to their phonological development. Quantitative and qualitative parameters were recorded and analyzed statistically by analysis of variance technique and means of treatments were compared by least significant difference test. Qualitative traits of selected weeds were determined through the methods developed by The Association of Official Analytical Chemists (AOAC). The results showed that the quantitative traits of weeds differ from each other. It was found that the moisture decreased from vegetative (86.13-90.92%) to post reproductive stage (86.77-73.56%) and crude protein decreased from vegetative (16.95-23.40%) to post reproductive stage (11.52-15.09%) in all weeds. Similarly ash contents decreased from vegetative (13.72-23.40%) to post reproductive stage (9.26-13.11%) in all weeds. The crude fats were nearly similar in all stages (1.75-2.00%). Dry matter and crude fiber increased (9.08-13.87 to 13.23-26.44% and 9.86-21.95 to 21.58-31.63%, respectively) from vegetative to post reproductive stage. Overall results declared that the biomass produced by weeds was a luxurious source for livestock production during the vegetative stage of growth as the nutritional quality decreased from vegetative to post reproductive stages. Further research is needed to explore the forage quality of all common weeds present in croplands.

Introduction

Livestock is very important to the economy of rural areas as it has handsome share in GDP of Pakistan. But due to competition with common cash crops, area cultivated under fodders is decreasing day by day. Sarwar et al. (2012) said that livestock production hampers due to shortage of fodder during cold winter and hot summer. Therefore, the unavailability of quality feed considerably limits the livestock rearing. So, it is the need of the time to look for some new

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naturally blessed feed resources that would not have any competition with the human food chain. Indigenous weeds or forages create an opportunity for native dairy producers to devote them as valuable feed resource. Belsky and Gelbard (2000) confirmed that some weeds have tasty aerial parts making them tuti-fruity flavor for domesticated animals, while few of them have undesirable quality reducing elements in feed (e.g. high nitrates and heavy metals etc.) that results bad odor and flavor to milk. Additionally, some weed species may be injurious, noxious and less palatable. Some grasses are well known for horse feeding. Khan et al. (2013) reported that the grasses could be essential source of fiber while broadleaved weeds can have adequate crude protein contents and inorganic minerals contents. In comparison to cultivated fodder crops, weeds are more starchy and have good percentage of crude protein. The proximate of chemical composition of weeds provides us valuable knowledge of nutrients variability and dynamics among different stages of development of each weed species during its growing period. Therefore, producers should know the nutritiousness of any available feed source to manage livestock development, growth, and reproduction (Ganskopp and Bohnert, 2001). The basic aim of the study was to introduce some locally available weed species as an alternative potential feed resource. Weeds under this study include following charateristics: *Bromus tectorum* L. is an annual winter grass. Its leaves are flattened and twisting. Leaves are covered with small smooth hairs (Menalled et al. 2008). *Raphanus raphanistrum* L. is a broadleaved winter annual weed that have single alternate leaves arrange in rosette fashion. Its branches have hair like thorns (Malik, 2009). *Lathyrus aphaca* L. is a broadleaved annual weed. Its leaves turn themselves into climbing soft tendrils. The previous leaves have paired leaflets while the following leaves are 1-3 cm lengthy, sessile, green and opposite (INRA, 2007). *Parapholis incurva* L. have glabrous leaves and stem. Stems are 5-20 cm long while leaves are 0.25 cm wide (VRO, 2015). *Setaria viridis* L. is narrow leaved weed. Its leaves are 4-15 cm wide and 5-30 cm lengthy, green in color, glabrous on underside, flat, and serrated from margins (Douglas et al. 1985). *Avena fatua* L. is a self-pollinated winter annual grass. It has flat, long (20-30 cm) and wide (1 cm) leaves. The sheathed blade is present and the bases of the leaf blades often hairy (Sharma and Born, 1978). *Phalaris minor* Retz. is a winter annual weed that is bluish-green in color. The flat, broad and tender leaves are nearly 15 cm long and do not have hairs on their surface (UCIPM, 2016). It is one of the most important cereal weeds that may cause yield losses through competition for inputs (Mehdizadeh and Alebrahim, 2015).

Materials and Methods

The following study was conducted to evaluate the nutritional quality of different weed species during 2016 using randomized complete block design with 3 replications. There were 7 treatments (weed species) including *Lathyrus aphaca* L. *Raphanus raphanistrum* L. *Phalaris minor* Retz., *Avena fatua* L., *Bromus tectorum* L., *Parapholis incurva* L. and *Setaria viridis* L. The various quantitative (height, number of leaves, tiller per plant, fresh and dry weight per plant) and qualitative characteristics (moisture, crude protein, crude fat, crude fiber and ash) were studied. Fisher's analysis of variance technique and least significance difference test (LSD) at 5% probability were used to test the significance of treatments' means (Steel et al. 1997). The quantitative traits were recorded at maturity stage. The plant height of 15 randomly selected weeds from every plot of all treatments was measured with meter rod from base to the tip of flag leaf at maturity stage. Then mean height was calculated. Then the total number of leaves and tillers per plant were determined. The fresh weight per plant at maturity stage was measured with balance. Then the similar plants were dried under shade for three days. Latter on theses samples were oven dried at 65°C until constant dry weight per plant was gained then their dry weights was measured with an electronic balance.

For quality analysis, samples were taken at vegetative (45 days after sowing), reproductive (65 days after sowing) and post-reproductive stage (85 days after sowing). The moisture content, crude protein (CP), ether extractable crude fat (EECF), crude fiber (CF) and ash was determined by using standard procedure of AOAC (1990). The moisture of weighed plant sample was by drying it at 105ºC till constant weight. Crude protein was determined through micro Kjeldahl method. For ash, sample was ignited in muffle furnace at 550°C to burn all the organic matter and leftover was weighed as ash. Crude fat was determined by using soxhlet apparatus through ether extraction method. Crude fiber of fat free samples was determined through 10% sulphuric acid and 10% sodium hydroxide treatment.

Results and Discussion

The analysis of variance confirms the significant difference among weed species regarding plant quantitative traits at maturity stage. The table 1 shows that significantly highest plant height was observed in *L. aphaca* (107.93 cm) and minimum plant height was observed in *B. tectorum* (34.13 cm). The differences of height in weed species may be due to the genetical and environmental factors. The results of this study were similar to the findings of Attis et al. (2012). They found that different fodder species vary in plant height. The table 1 shows that *P. minor* had significantly maximum number of leaves per plant (69.91) and minimum was reported in *P. incurva* (10.75). The table 1 shows that significantly maximum number of tillers per plant was observed in *A. fatua* (13.11) and minimum were observed in *L. aphaca* (2.58). Naeem et al. (2003) also reported significant differences among various cultivars of *P. americanum* L. regarding number of leaves per plant and number of tillers per plant. The maximum fresh weight per plant was observed in *A. fatua* (224.26 g) that was statistically at par with that of *P. minor* (171.20 g) and minimum fresh weight per plant was observed in *P. incurva* (2.39 g) as shown in table 1. The maximum dry weight per plant was observed in *A. fatua* (25.51 g) and minimum dry weight per plant was observed in *B. tectorum* (0.53 g) which was statistically not different from that of *S. viridis* (0.65 g) and *L. aphaca* (0.62 g) as shown in table 1. The results of this study were similar to the findings of Afzal et al. (2012). They reported that different cultivars of *S. bicolor* differ in fresh and dry weight per plant.

Table 1. Quantitative traits of selected weed species at maturity stage.

Weed species	Plant height (cm)	No. of leaves per Plant	No. of tillers per plant	Fresh weight per plant (g)	Dry weight per plant (g)
Bromus tectorum	34.13 [e]	15.00 [bc]	4.11 [c]	2.69 [c]	0.53 [b]
Setaria viridis	45.83 [d]	11.00 [c]	3.34 [c]	3.49 [c]	0.65 [b]
Avana fatua	85.65 [c]	24.22 [b]	13.11 [a]	224.26 [a]	25.51 [a]
Parapholis incurva	40.18 [de]	10.75 [c]	3.97 [c]	2.39 [c]	0.91 [b]
Phalaris minor	96.26 [b]	68.91 [a]	8.56 [b]	171.20 [ab]	18.70 [a]
Lathyrus aphaca	107.93 [a]	22.25 [b]	2.58 [c]	4.52 [c]	0.62 [b]
Raphanus raphanistrum	80.65 [c]	15.98 [bc]	9.91 [b]	75.44 [bc]	6.07 [b]
LSD (0.05)	9.37	10.18	2.36	145.09	11.70

Columns having the same letters within the column are non-significantly different at 5% significant level.

The analysis of variance shows that means were significantly different in their nutritional traits for all stages under study. The table 2 shows that maximum moisture at vegetative stage was observed in *R. raphanistrum* (93.17 %) while minimum was observed in *P. incurva* (77.99 %). The maximum moisture at reproductive stage was observed in *A. fatua* (91.43 %) while minimum was observed in *P. incurva* (70.28 %). The maximum moisture at post reproductive stage was observed in *R. raphanistrum* (88.66 %) and minimum was observed in *P. incurva* (65.01%). The table 2 shows that maximum EECF at vegetative stage was observed in *R. raphanistrum* (2.42 %) while minimum EECF was observed in *L. aphaca* (1.70 %). At reproductive stage, the maximum EECF was observed in *P. incurva* (2.22 %) while minimum in *R. raphanistrum* (1.67 %). At post flowering stage, maximum EECF was observed in *R. raphanistrum* (2.25 %) and minimum in *P. incurva* (1.80 %). The analysis of variance shows that CF of different weeds was significantly different at all stages under study. The table 2 shows that maximum fiber at vegetative stage was observed in *A. fatua* (25.13 %) while minimum CF was observed in *R. raphanistrum* (6.10 %). At reproductive stage, maximum fiber was observed in *P. incurva* (27.61 %) while minimum was observed in *R. raphanistrum* (7.83

%). At post-reproductive stage, maximum fiber was observed in *B. tectorum* (33.65 %) while minimum crude fiber at post flowering stage was observed in *R. raphanistrum* (16.96%).

Table 2. Qualitative characteristics of selected weed species at vegetative, reproductive and post reproductive phenological stage**.**

Weed Species	Moisture (%)	Crude Fat (%)	Crude Fiber (%)	Crude Protein (%)	Ash (%)
Vegetative Stage (45 days after sowing)					
Bromus tectorum	85.76 ^{cd}	2.33 ^{ab}	18.15 ^{c}	20.61 ^{b}	15.78^{c}
Setaria viridis	83.38 ^{d}	2.12 ^{abc}	20.50 ^{bc}	14.29 ^{c}	14.30 ^{cd}
Avana fatua	91.20 ^{ab}	1.97 ^{bc}	25.13 ^{a}	12.94 ^{c}	11.15 ^{d}
Parapholis incurva	77.99 ^{e}	1.72 ^{c}	23.20 ^{ab}	19.42 ^{b}	14.30 ^{cd}
Phalaris minor	92.33 ^{ab}	2.38 ^{ab}	22.78 ^{ab}	17.50 ^{bc}	13.07 ^{cd}
Lathyrus aphaca	88.66 ^{bc}	1.70 ^{c}	13.63 ^{d}	21.94 ^{ab}	19.36 ^{b}
Raphanus raphanistrum	93.17 ^{a}	2.42 ^{a}	6.10 ^{e}	25.67 ^{a}	27.43 ^{a}
LSD (0.05)	3.68	0.43	4.20	4.82	3.22
Reproductive Stage (65 days after sowing)					
Bromus tectorum	81.74 ^{b}	2.03 ^{a}	25.65 ^{ab}	13.42 ^{c}	11.52 ^{bc}
Setaria viridis	83.38 ^{b}	2.12 ^{a}	20.50 ^{b}	14.29 ^{c}	14.30 ^{b}
Avana fatua	91.43 ^{a}	1.90 ^{a}	24.57 ^{ab}	11.04 ^{c}	14.12 ^{bc}
Parapholis incurva	70.28 ^{c}	2.22 ^{a}	27.61 ^{a}	14.06 ^{c}	10.80 ^{c}
Phalaris minor	84.92 ^{b}	2.05 ^{a}	22.18 ^{b}	15.04 ^{bc}	11.85 ^{bc}
Lathyrus aphaca	90.08 ^{a}	1.87 ^{a}	21.65 ^{b}	18.49 ^{b}	14.91 ^{b}
Raphanus raphanistrum	90.75 ^{a}	1.67 ^{a}	7.83 ^{c}	23.40 ^{a}	24.95 ^{a}
LSD (0.05)	3. 92	0.61	5.20	4.18	3.48
Post reproductive stage (85 days after sowing)					
Bromus tectorum	73.11 ^{b}	2.15 ^{a}	33.65 ^{a}	9.94 ^{bc}	9.63 ^{b}
Setaria viridis	77.41 ^{b}	2.17 $_{a}$	33.06 ^{a}	13.74 $_{b}$	9.21 ^{b}
Avana fatua	78.21 ^{b}	1.98 ^{a}	27.13 ^{b}	8.39 ^{c}	9.40 ^{b}
Parapholis incurva	65.01 ^{c}	1.80 ^{a}	33.37 ^{a}	13.13 ^{b}	8.87 $_{b}$
Phalaris minor	74.05 ^{b}	2.05 ^{a}	30.96 ^{ab}	12.40 ^{b}	9.17 $_{b}$
Lathyrus aphaca	84.88 ^{a}	1.94 ^{a}	26.20 ^{b}	11.72 ^{bc}	13.00 $_{a}$
Raphanus raphanistrum	88.66 ^{a}	2.25 ^{a}	16.96 ^{c}	18.48 ^{a}	13.21 ^{a}
LSD (0.05)	6.28	0.57	5.15	3.99	3.22

Columns having the same letters within the column are non-significantly different at 5% significant level.

Table 2 shows that maximum CP at vegetative stage was observed in *R. raphanistrum* (25.67 %) while minimum was observed in *A. fatua* (12.94 %) that was not significantly different from *S.*

viridis (14.29 %). At flowering stage, the significantly maximum CP was observed in R. raphanistrum (23.40 %) while the minimum CP was observed in *A. fatua* (11.04 %). At post-reproductive stage, the significantly maximum CP was observed in *R. raphanistrum* (18.48 %) while minimum CP was observed in *A. fatua* (8.39 %). The table 2 shows that significantly maximum ash was observed in *R. raphanistrum* (27.43 %) followed by that of *L. aphaca* (19.36 %) while minimum was observed in *A. fatua* (11.15 %) at vegetative stage. At reproductive stage, significantly maximum ash was observed in *R. raphanistrum* (24.95 %) while minimum ash was observed in *P. Incurva*. At post reproductive stage, maximum ash was observed in *R. raphanistrum* (13.21 %) while minimum was observed in *P. incurva* (8.87 %). The quality of fodder weed species depends upon their inbuilt capacity to achieve desired nutrient elements from the soil. Based on findings, it is declared that the quality of forage weeds decreased from vegetative stage to post reproductive stage. Achakzai et al. (2009) said that changes associated with the advancement of stage. The moisture, CP and ash contents decreased as the weed species got matured, while DM and CF contents increased with the advancement in growth stage. As the weed species matured, decreased leaf to stem ratio and increased fibers in stems and leaf resulted these differences. Similar findings were reported by Khan et al. (2014). They confirmed that moisture, CP and ash of weeds decreased from vegetative stage to post reproductive stage. They also found that crude fiber contents increased from vegetative phase to post reproductive stage. Pallabi et al. (2013) reported that lipid contents in giant fern (*Angiopteris evecta* G.Frost.) and slender amaranth (*Amaranthus viridis* L.) were nearly same at all stages that matched with our results.

Conclusion

Based on our findings, it could be concluded that different narrow and broadleaved weeds are rich source of nutrient elements for raising a healthy livestock system. These weed species could efficiently replace any cultivated fodder crop and could be used as alternate feed source if there is limited availability of quality fodder.

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Conflicts of Interest

No conflicts of interest have been declared.

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