

Mix cropping of smooth vetch and barley under cold rainfed conditions

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Introduction

Drylands are mainly used for wheat and food legumes production and there is increasing demand to forage crops in these areas. About 2-3 million hectares of arable lands across Iran are left as fallow every year (Alizadeh, 2010) which could be used to suitable forage crops. Considerable variation has been reported in herbage and grain yields of improved vetches (*Vicia* spp.) under Iranian rain-fed conditions. Introduction of annual feed legumes in dryland cropping systems that are dominated by cereals would reduce pest and disease risk and increase sustainable productivity. However, vetch species as monocultures produce low forage yield under cold dryland conditions. Mixtures of annual feed legumes with winter cereals have greater potential for forage production in the rain-fed conditions (Lithourgidis *et al.*, 2006). Pure stands of most feed legumes are damaged during winter in autumn planting under cold dryland conditions and monocultures of feed legumes as spring crop do not provide remarkable results for forage production in highlands (Alizadeh and da Siva, 2013). On the other hand, winter cereals provide high yields in terms of dry weight but they produce forage with low protein and the forage quality of cereal hay is generally lower than that required to meet production goals for many livestock classes (Lawes and Jones, 1971). In legume-cereal mixtures, companion cereals provide structural support for legumes, improve light interception, and facilitate mechanical harvest, meanwhile legumes in mixtures improves the quality of forage (Thompson *et al.*, 1992). Dhima *et al.* (2007) reported that there was an advantage of intercropping for exploiting the resources of the environment. Other benefits of mixtures include greater uptake of water and nutrients, enhanced weed suppression, and increased soil conservation (Abbas *et al.*, 2001).

The species from both cereals and legumes which are used in mixtures have different competitions and interaction level. Anil *et al.* (1998) reported that triticale can be used as an alternative cereal for mixtures with common vetch. Lithourgidis *et al.* (2006) reported that the mixture of common vetch with oat at the 65:35 seeding ratio gave the highest forage yield. Despite the fact that competition is one of the factors that can affect forage yield and quality there are no reports on the effect of different cereals and different seeding rates on the growth rate of legume-cereal mixtures. Competition can also have a significant effect on growth rate of the different species used in mixtures (Lithourgidis *et al.*, 2006). This differences in seeding ratios could have been because of the species of grass and legume in the mix cropping as well as different soil properties and climatic conditions in the research regions. Alizadeh and da Silva (2013) reported that autumn seeding of smooth vetch (cv. Maragheh) and barley (cv. Abidar) in 1:1 ratio produces considerable forage in terms of quantity and quality. The objective of the present work was to evaluate biomass yield and protein content in some mixtures of barley with smooth vetch at different seed rates along with pure stands under cold dryland conditions.

Materials and Methods

Smooth vetch (*Vicia dasycarpa* L.) cv. Maragheh and barley (*Hordeum vulgare* L.) cv. Abidar were studied at Dryland Agricultural Research Institute (DARI) during two years (2009-2010 and 2010-2011) in the North-west Iran. The soil type was Rajal Abad fine Mixed Mesic Calcixerollic Xero Chrepts based on USDA soil taxonomy. The intercropping treatments comprised of 100% smooth vetch, 75% smooth vetch+ 25% barley, 50% smooth vetch+ 50% barley and 100% barley. There was one seeding rate (100 seeds m⁻²) for barley and different seed densities of smooth vetch including 100, 150, 200, 250, 300 seeds m⁻² which designed as D₁, D₂, D₃, D₄ and D₅ respectively.

Experimental fields were prepared by chisel in the end September 2009 and 2010 which followed by replacement of appropriate N-P fertilizer where, 40 kg ha⁻¹ N and 20 kg ha⁻¹ P₂O₅, was uniformly applied to the soil.

Hays were harvested when legume plants reached the beginning of the pod formation stage and fresh biomass was measured.

Results and Discussion

Based on the combined analysis of the results, there were significant differences between planting ratios regarding fresh biomass in the mixed smooth vetch and barley. Effect of years and treatment by year interaction was not significant in this study. The means were higher in the second year (The means were not shown). This may be due to suitable temperatures and distribution of annual precipitation during 2010-2011 comparing the first year. The highest forage yield was obtained with pure stands of barley that was not significantly different from 75:50 smooth vetch:barley ratio over years (Fig. 1). Sole cropping of smooth vetch produced the lowest forage yield, without any difference at different seeding rates (Fig. 1). Many studies also have declared on advantages and economical aspects of mixed and intercropping than pure stands, especially for forage production (Abbas *et al.*, 2001). Osman and Osman (1982) studied mixtures of sorghum and a legume forage in the Sudan and observed that the highest yield was reached with 1:1 ratio of cereal-legume. Posler *et al.* (1993) evaluated compatibility of grass-legume mixture and stated almost all mixtures attained more

yields than monocultures of grasses. It has been already reported that legumes are richer in protein, whereas grasses have higher carbohydrate content and their forage quality is too low to meet satisfactory production of many animal groups (Thompson *et al.*, 1992). Therefore, concerning the relative low protein content of cereals and animal requirements for balanced feed, the importance of mixed cereal-legume cropping would be more critical (Karadag and Buyukburc, 2004). Similar to our results, Osman and Osman (1982) also found the highest and the lowest crude protein percentage in legume and cereal sole cropping, respectively and as legume ratio increased in mixture, protein percentage of mixture forage was improved. Posler *et al.* (1993) reported all legumes enhanced forage crude protein in mixture compared to cereals sole cropping, as also was observed by others in inter- and mixed cropping of different legume and grasses species (Lithourgidis *et al.*, 2006).

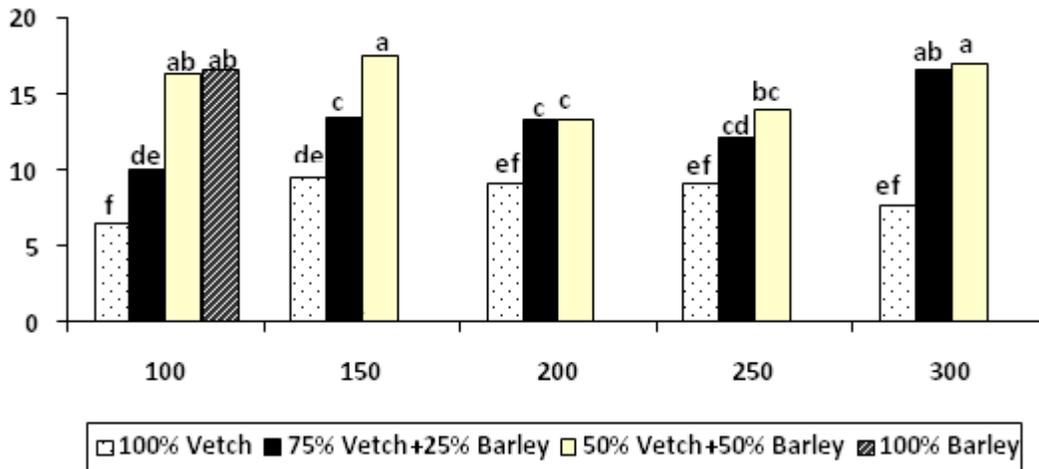


Fig. 1. Mean fresh biomass production over two years (2009-2011) in different mixtures of smooth vetch and barley at different seed density. Means followed by the same letters are not significantly different according to DMRT ($P = 0.05$) across all treatments

Conclusion

It was concluded that mix cropping of smooth vetch and barley in proper ratio could increase land productivity and forage production and enhance feed nutrient composition. Thus, using cereal-legume mixed crops, such as barley and smooth vetch can enhance dry season feed availability, leading to more sustainability of low-input and traditional agricultural systems, as well as modern and organic agro-ecosystems.

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