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Balwinder Kumar

Guru Angad Dev Veterinary and Animal Sciences University, India

R. S. Sarlach

Punjab Agricultural University, India

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The 23rd International Grassland Congress (Sustainable use of Grassland Resources for Forage Production, Biodiversity and Environmental Protection) took place in New Delhi, India from November 20 through November 24, 2015.

Proceedings Editors: M. M. Roy, D. R. Malaviya, V. K. Yadav, Tejveer Singh, R. P. Sah, D. Vijay, and A. Radhakrishna

Published by Range Management Society of India

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Influence of foliar sprays of thiourea and sulfuric acid against frost injury in berseem

Balwinder Kumar^{1*}, R. S. Sarlach²,

¹Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India

²Punjab Agricultural University, Ludhiana, Ludhiana, India

*Corresponding author e-mail : dr.balwinderkumar@rediffmail.com

Keywords: Berseem, Foliar spray, Green fodder yield, Seed yield, Thiourea

Introduction

Berseem (*Trifolium alexandrinum* L.) is an important winter season fodder crop which occupies 2 million ha area in India (Kumar *et al.*, 2013). Berseem is generally grown as pure stands or in mixture with annual grass species for feeding to the livestock. During severe winter month periods from December to February, berseem growth is slow due to low minimum air temperature or cold wave or frost occurrence which affects fodder availability to the livestock. To increase growth of berseem either in pure stand or in mixture, farmers generally use excessive urea which not only affects nodule development in roots of legumes but also pollute the environment (Dogra and Dudeja, 1993). Mixture of berseem clover with cereal crop enhances total dry matter yield, improves fodder quality, reduces fertilizer use and also increases subsequent crop yield (Ross *et al.*, 2004). Farmer harvests 3-4 cuttings of berseem up to late mid April as fodder for livestock and then leave the crop for seed production. After 3-4 cuts as green fodder, berseem plants retain less foliage, poor flowering and finally low seed production (Kumar *et al.*, 2013). It is very essential that berseem crop attains sufficient height and tillering capacity during initial cuts for obtaining high fodder yield during slow growth and later on crop left for seed production produces good quantity and quality of seed. So, keeping this objective in view, a field experiment was designed to know the effect of different chemical foliar sprays during early cuts on the growth of berseem grown as pure stand and in mixture against very low minimum air temperature/frost injury.

Materials and Methods

Field experiments were conducted during two consecutive years in 2009-10 and 2010-11 at the Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana (30°56' N, 75°52' E, 247 m above sea level), India. The soil of the experimental field was loamy sand in texture having pH 7.8, with 0.4% Walkley and Black carbon, 15.0 kg P ha⁻¹ Olsen P and 347 kg K ha⁻¹ NH₄OAc-extractable K. The total amount of rainfall received during the crop seasons from October to June were 117.5 mm and 164.4 mm in 2009-10 and 2010-11, respectively. During the year 2009-10, mean minimum air temperature during the month of December, January and February were 6.5 °C, 6.6 °C and 9.9 °C where as during the year 2010-11 corresponding figures were 5.6 °C, 5.2 °C and 8.8 °C respectively. Number of days with <5 °C minimum air temperature during the months of December, January and February were 11, 6 and 1 while during the year 2010-11 number of days were 12, 20 and 0 days, respectively. Minimum air temperature was <3 °C for 3 days in the month of December during 2009-10 and for 5 days during the month of December and January in the year 2010-11. Frost occurred for one day in the month of December during 2009-10 while for 11 and 15 days in the month of December and January during the year 2010-11. Mean monthly maximum and minimum air temperatures recorded were in May *i.e.* 40.2 °C and 24.4 °C, and 39.4 °C and 25.0 °C during the year 2009-10 and 2010-11, respectively. The treatments included combinations of two mixture (Berseem pure stand and Berseem + Oat mixture) and 4 combinations of chemical sprays and their concentrations, namely thiourea at 0.05%, thiourea at 0.1%, H₂SO₄ 0.05% and H₂SO₄ at 0.1%. An additional untreated control was also included in the study. The experiment was laid out in a factorial randomized complete block design with three replications. Two foliar sprays of the thiourea and diluted H₂SO₄ were applied at one week interval 10 days after first and second cut. The cultivar BL 42 of berseem and Kent of oat was used in this study. The crop was sown as per treatment in plot area of 10.5 m² on October 20 and October 16 during the year 2009-10 and 2010-11, respectively. Four cuts of green fodder were taken from each plot up to mid April and after then crop was left for seed production. As green fodder, 1st, 2nd, 3rd and 4th cuts were taken in 4th week of December, 1st week of February, 2nd week of March and 2nd week of April during both the years of study.

Results and Discussion

Berseem + oat mixture recorded significantly higher green fodder yield by 7.0% than pure stand of berseem (Table 1). Ross *et al.* (2004) also recorded higher tonnage of green fodder in cereal-berseem clover intercrops than berseem clover sole crop. Among different chemical foliar treatments, foliar sprays of thiourea and H₂SO₄ recorded significantly higher

green fodder yield than control due enhanced growth of crop in subsequent cuts after 1st cut (data not reported). Foliar spray of 0.05% thiourea on crop recorded 11.2%, whereas dilute sulfuric acid at 0.05 and 0.1% led to 5.2 and 8.0% increase in green fodder yield over control. Meena *et al.* (2012) also recorded higher growth parameters such as plant height and number of branches in mustard crop sprayed with H₂SO₄ and thiourea during frost occurrence. In our study, fodder mixture and foliar sprays of chemicals influenced berseem biological yield and seed yield significantly (Table 1). Among fodder mixture treatments, significantly higher biological yield, seed yield and harvest index were recorded in berseem pure stand than berseem + oat mixture. Different foliar treatments of thiourea and dilute sulfuric acid recorded significantly higher berseem plant height (at harvest), biological yield and seed yield over control. Foliar spray of thiourea at 0.05% recorded 21.1% higher berseem seed yield than control and found to be at par with 1.0% thiourea and H₂SO₄ foliar sprays. Kumar *et al.* (2013) also recorded higher seed yield of berseem with foliar application of different bio-regulators such as salicylic acid and KNO₃ during flowering than control. Meena *et al.* (2012) also reported higher seed yield and seed yield attributes in mustard with foliar sprays of H₂SO₄ and thiourea during frost occurrence in state of Rajasthan in India.

Table 1. Effect of different mixture and foliar chemical sprays against frost injury on green fodder, seed yield attributes and seed yield of berseem (mean data)

Treatments	Green fodder yield (q ha ⁻¹)	Berseem			
		Plant height at harvest (cm)	Biological yield (q ha ⁻¹)	Seed yield (q ha ⁻¹)	Harvest index
Mixture					
Berseem pure	618.4	55.0	60.0	8.91	14.9
Berseem + oat	661.1	56.0	55.6	7.92	14.3
CD (p=0.05)	10.8	NS	2.1	0.4	0.4
Foliar treatments					
Control	599.7	52.7	50.0	7.45	14.9
Thiourea 0.05%	666.9	58.0	64.0	9.05	14.2
Thiourea 0.1%	653.3	57.6	61.0	8.73	14.3
H ₂ SO ₄ 0.05%	631.1	54.5	55.9	8.17	14.7
H ₂ SO ₄ 0.1%	647.8	55.2	58.6	8.71	14.9
CD (p=0.05)	17.1	2.6	3.4	0.6	NS

Conclusion

Higher green fodder yield can be obtained from berseem + oat fodder mixture than pure berseem stand while reverse is true for obtaining berseem seed yield. During harsh winter months when very low minimum air temperature or frost injury occurs, two foliar sprays of thiourea at 0.05% at weekly interval 10 days after 1st and 2nd cut is promising in enhancing green fodder and seed yield of berseem grown in pure stand and in mixture with oat.

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Acknowledgement

We thank Head, Department of Animal Genetics and Breeding, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India for providing necessary inputs to conduct this research trial.