The Effect of Varying Oat-Pea Seeding Rates on Forage Quality and Quantity

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Summary with Implications

Variable oat-pea seeding rates were evaluated to determine the effects of seeding rate on forage quality and quantity across a precipitation gradient from western to eastern Nebraska. The first year of data collected in the spring of 2017 from sites in Lincoln, North Platte, and Sidney, NE are reported here. Total forage production was greatest at the Lincoln site and did not show significant differences in forage yield between seeding rates. At the other locations, total production was greatest when mixtures were seeded with at least 35 lbs. per acre of oat (Avena sativa L.). Percent crude protein was greatest with the pea (Pisium sativa L.) monoculture and with at least 52.5 or 35 lbs. of peas per acre in Lincoln and North Platte, respectively. However, at the driest site in Sidney, no differences were detected for crude protein or total digestible nutrients between all the seeded mixtures. It is beneficial for producers to understand how forage responds under different environmental conditions and what level of forage quality will meet their livestock needs so they can economically utilize the best oat-pea mixture ratio for their location.

Introduction

A main goal when integrating crop and livestock systems is to economically produce a forage crop that meets the needs of the livestock producer. Oat-pea mixtures are cool-season annual forages that are used across a wide variety of climate conditions to maximize forage production of oats with the potential to improve forage quality, and possibly add nitrogen fixing benefits, from the forage peas. However, the addition of pea to a mixture can increase the cost of seed (Oat seed = $0.28 to $0.31 vs Pea seed = $0.39 per pound). Previous research has shown that the seeding ratios of these mixtures can be manipulated to alter the quantity and quality of feedstuff being produced. Although, it is less understood how different seeding rates respond to different environmental conditions. Mean spring precipitation (March to June) is important for cool-season grass production and varies from a mean of about 8.7 inches in western NE to 13.3 inches in eastern Nebraska. The objective of this research project was to compare variable seeding rates of oats and peas across Nebraska's precipitation gradient from west to east to determine which mixture provides the greatest quantity and quality at each location.

Procedure

The study began in 2017 with research plots in western Nebraska (i.e., Sidney), central Nebraska (i.e., North Platte), and eastern Nebraska (i.e., Lincoln). At each location five different oat-pea seeding rates were planted into plots measuring 5 feet by 30 feet using a randomized block design with 4 replications. Seeding rate treatments used include *0% Oats* (0 lbs. · ac^{-1} Jerry Oat / 70 lbs. · ac^{-1} Spring Forage Pea 4010), *25% Oats* (17.5 lbs. · ac^{-1} Oat/52.5 lbs. · ac^{-1} Pea), *50% Oats* (35 lbs. · ac^{-1} Oat/35 lbs. · ac^{-1} Pea), *75% Oats* (52.5 lbs. · ac^{-1} Oat/17.5 lbs. · ac^{-1} Pea), and *100% Oats* (70 lbs. · ac^{-1} Oat/ 0 lbs. · ac^{-1} Pea). Planting dates were 04/06/2017 in Sidney, 04/06/2017 in North Platte, and 03/27/2017 in Lincoln. All plots were fertilized with 60 lbs. of nitrogen and 30 lbs. of phosphorus approximately 1 month after the plantings occurred at each location. Plots were harvested in early to mid-June at the approximate soft dough stage of the oat (Sidney = June 19, North Platte = June 19, Lincoln = June 7). Samples were hand-clipped and separated to determine the proportion of the mixture that was oats and peas for each seeding rate treatment. To determine total production, the plots were harvested at a stubble height of 4 inches using a carter forage harvester. All production samples were oven dried to a constant weight and results are reported on a dry matter basis.

Grab samples were then taken from the harvested material and analyzed using a wet chemistry analysis by Ward Labs to determine crude protein (CP) and total digestible nutrients (TDN). March through June precipitation was 7.2 inches in Sidney, 7.1 inches in North Platte, and 18.8 inches in Lincoln. Due to abnormally dry conditions in late May and June in North Platte 3.3 inches of water was applied through irrigation for a total of 10.4 inches (irrigation plus rainfall from March to June). Different seeding rates were compared at each location using a mixed model analysis of variance in SAS.

Results

In 2017, total forage production of the seeding rate treatments differed ($P < 0.05$) at the western and central locations, but not at the eastern site ($P < 0.70$). The monoculture of oats in Sidney and the 75% oat mixture in North Platte had the greatest amount of total forage production at their respective locations, but these treatments were only statistically different from treatments with 0% and 25% oats at each location. In Sidney, total forage production from the 100% oat treatment was at least 70% greater than production of mixtures with 0% and 25% oats, but not different from treatments with at least 50% oats in the seeding rate. At the Lincoln location, the mixtures showed no statistical differences in production, but the highest yielding was the 50% oat mixture. The monoculture of peas produced the least amount of forage at all three locations, but was only statistically different from the 75% oat mixture in North Platte and the 100% oat mixture in Sidney (Table 1).

Crude protein at the central and eastern

Table 1. Comparison of production, total digestible nutrients, and crude protein of oat and pea mixtures planted at different seeding rates at 3 locations in Nebraska

		Seeding Rate Treatments (lbs. * ac^{-1})											
Study location		Oat 0# pea 70#		Oat 17.5# pea 52.5#		Oat 35# pea 35#		Oat 52.5# pea 17.5#		Oat 70# pea 0#		SE	P-value
Lincoln													
Total production	(lbs · ac^{-1})	7202		7220		8866		8162		7811		1028	0.70
Oat production	(lbs · ac^{-1})	0	C[1]	4579	B	7439	A	7842	A	7811	A	900	<0.01
Pea production	(lbs · ac^{-1})	7202	A	2641	B	1426	B	320	C	0	D	485	<0.01
TDN	(%)	50		51		49		51		50		2	0.86
	(lbs · ac^{-1})	3559		3708		4288		4174		3848		416	0.62
Crude protein	(%)	20	A	18	AB	15	BC	14	BC	11	C	2	0.03
	(lbs · ac^{-1})	1447	A	1321	A	1246	A	1109	AB	825	B	117	0.04
North Platte													
Total production	(lbs · ac^{-1})	4387	B	5002	B	6280	AB	6430	A	5440	AB	448	0.03
Oat production	(lbs · ac^{-1})	0	D	1162	C	4153	A	4801	AB	5440	A	338	<0.01
Pea production	(lbs · ac^{-1})	4387	A	3840	A	2127	B	1628	B	0	C	430	<0.01
TDN	(%)	58		57		58		59		57		1	0.77
	(lbs · ac^{-1})	2529	B	2822	B	3625	A	3763	A	3112	AB	277	0.02
Crude protein	(%)	19	A	17	A	18	A	14	B	9	C	1	<0.01
	(lbs · ac^{-1})	835	B	869	B	1164	A	900	AB	488	C	105	<0.01
Sidney													
Total production	(lbs · ac^{-1})	1932	B	2016	B	2581	AB	2826	AB	3430	A	340	0.05
Oat production	(lbs · ac^{-1})	0	D	1544	C	2146	BC	2606	AB	3430	A	307	<0.01
Pea production	(lbs · ac^{-1})	1932	A	472	B	434	B	220	B	0	C	137	<0.01
TDN	(%)	55		-[2]		57		57		55		2	0.46
	(lbs · ac^{-1})	1059	C	-		1356	BC	1592	AB	1803	A	125	<0.01
Crude protein	(%)	20		-		17		17		16		2	0.27
	(lbs · ac^{-1})	383		-		420		483		536		52	0.06

[1](a,b,c,d) Different letters within a row represent significant ($P < 0.05$) difference between the seeding rates

[2]Forage quality data was not analyzed at the Sidney site for the treatment Oat 17.5#/Pea 52.5# because of lost samples

sites typically followed the expected pattern of decreasing CP as the proportion of pea in the treatments decreased, but at the western location CP was not different between the different seeding rate treatments. At the central location, treatments of 0%, 25%, and 50% oats produced the greatest percent CP while in Lincoln it was treatments with 0% and 25% oats.

Total CP production was calculated as the total lbs. · ac^{-1} to determine what mixtures had the greatest amount of CP available based on the amount of forage produced. Again, the central and eastern location showed significant differences with reduced pea seeding rates. The treatment of 100% oat produced the lowest production of CP on a per acre basis at both the central and east location. No differences were detected in total CP across the treatments at the western site. At the central location treatments with 50% and 75% oats produced the greatest total CP production while treatments with 0%, 25%, 50%, and 75% oats performed best in the east. No significant differences ($P > 0.05$) were found for TDN between the 5 seeding ratios at any of the 3 locations. Estimated seed costs for planting a pea monoculture were $27 per acre (70 lbs. of pea at $0.39 per lb.), the 50% oat mixture seed costs were $24 per acre, and the oat monoculture seed costs were the cheapest at around $20 per acre.

Conclusion

It is important for producers to know the quality needs of the livestock utilizing the forage, which should factor into mixture selection. It would not be beneficial for a producer to grow a higher quality feedstuff than what the animal needs because the extra quality would go unutilized. Adding pea up to half of the seeding rate did not negatively affect total production at all of the locations. At the eastern location, at least half of the seeding rate in pea was needed to increase CP in the forage compared to the oat monoculture. At the central location, adding only 17.5 lbs. of pea seed to the mixture increased the total available crude protein compared to oats alone. At the western site, planting only oats provided the greatest production without a large reduction in forage quality compared to the rest of the treatments. For producers in central and eastern Nebraska, planting an oat-pea mixture with 25 to 50% peas typically provided comparable production to only planting oat, but with greater crude

protein levels. While more research is needed in drier conditions of western NE, planting an oat monoculture may optimize production while still maintaining relatively good crude protein levels compared to oat-pea mixtures. According to year 1 data, if a producer is only focused on biomass production it would be beneficial to plant an oat monoculture to save money on seed cost while maximizing forage production.

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