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The Effects of Nitrogen and Phosphorus Fertilization on the Plant Characteristics of Turkish Yellow Bluestem (*Bothriochloa ischaemum* L.)

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ABSTRACT

The study reports effects of nitrogen and phosphorus fertilizers on some plant growth characteristics and nutritive value of Yellow Bluestem (*Bothriochloa ischaemum* L.). The results showed that 150 kg N ha^{-1} yr^{-1} was optimum for most of the investigated characters except the frequency of leaves on shoots. However, application of 100 kg N ha^{-1} yr^{-1} resulted in increased leaf formation. A severe reduction in stem and leaf raw protein content was recorded at the second clipping. The results clearly indicate that phosphorus plays an important role in the uptake of nitrogen for plant height and number of tillers per plant.

Key Words: Yellow Bluestem; *Bothriochloa ischaemum* L.; N and P fertilizers

INTRODUCTION

Bluestems (*Bothriochloa* spp.) are highly apomictic in their reproductive behaviour, perennial, warm-season, bunchgrasses of Eurasian origin (Dabo *et al*., 1987). It grows to 0.3-0.5 m with creeping root-stock, erect culms, simple or sparingly branched above, glabrous or pubescent at nodes. It is popularly found in Afghanistan, India, Iraq, Pakistan, USSR, Turkey, south-western United States (Oklahoma, Texas, Kansas, Missouri, Arkansas) and is highly drought tolerant. It has annual water requirement of 375-100 mm. It can be grazed throughout the wingrows well in late summer and autumn, flowers from April to September. This group of warm-season grasses possesses C_4 photosynthetic pathway (Coyne & Bradford, 1985). Yellow bluestem is easy to establish, drought hardy, resistant to defoliation and produces quality forage in spring and summer, except in late summer through winter (Teague *et al*., 1996). This genus has many species that exhibit extreme variability in phenology, morphology, seed production, photosynthetic capacity, and water-use efficiency. Little information is available pertaining to the effects of various fertilizers treatments to the grass under the conditions of Turkey. The study was conducted to determine the effect of nitrogen and phosphorus fertilizers on some of growth characteristics and nutritive value of Turkish Yellow Bluestem (*Bothriochloa ischaemum* L.).

MATERIAL AND METHODS

Healthy and vigorous individuals of Yellow Bluestem clones collected from the natural grasslands of Antakya, located on the east Mediterranean coastal region of Turkey, were used as plant material in this investigation. The clones were planted in pots (22 x 18 x 25 cm.) filled with soil mixture containing soil and sand (2:1 ratio) in a greenhouse irrigated regularly and the weeds if any were removed soon after appearance during the whole of the experimental period. The effects of 0, 50, 100, 150 kg N (Urea) and 0, 40, 80, 120 kg P_2O_5 ha^{-1} yr^{-1} were examined. The whole calculated amount of phosphorus (P) and the half amount of nitrogen (N) per pot were applied before planting. Remaining nitrogen was applied after first clipping at 15 cm plant height. The plants were clipped two times at flowering stage during the whole investigation. Plant height and number of fertile and sterile tillers were recorded for each tiller before the harvest. Harvested material after taking fresh weight was dried at 78 °C for 24 h to determine the leaf dried weight. Nitrogen was estimated using Kjeldahal method (Kacar, 1977). The data were analysed by ANOVA using MSTATC computer software. The differences among means were compared using Duncans multiple-range test.

RESULT AND DISCUSSION

The results showed that nitrogen doses significantly affected plant height of Yellow Bluestem (Table I). The effect of 150 and 100 kg N ha^{-1} were statistically similar. In general, plant height was significantly affected by the amounts of N and P depending on stage of the clipping. Number of tillers of Yellow Bluestem was significantly affected with both fertilizers (Table II) such that the maximum number of tillers was observed when the pots were supplied with 150 kg N and 40 kg ha^{-1} P_2O_5. It was

Table I. Averaged plant height (cm) of Yellow Bluestem (*Bothriochloa ischaemum* L.) formed under different fertilizer combination at two clipping

Nitrogen Dosages (kg/ha)	P_2O_5 Dosages(kg/ha) 0		40		80		120	
	1st	2nd	1st	2nd	86.6	2nd	1st	2nd
0	71.3*	84.0	79.3	89.7	69.7	86.6	67.3	86.6
50	74.3	83.0	76.0	75.3	76.0	69.7	76.7	69.7
100	71.6	85.7	88.7	72.7	95.3	76.0	87.0	76.0
150	71.7	92.0	93.3	73.0	81.9	95.3	93.0	95.3

*P<0.05

Table II. The effect of nitrogen (N) and phosphorus (P) fertilizer dosages on the number of tiller and dried leaf rate (%) of Yellow Bluestem (*Bothriochloa ischaemum* L.) for two clipping

Number of tillers per plant				
N Dosages (kg / ha)	P_2O_5 Dosages (kg/ha)			
	0	40	80	120
0	15.5 *	21.8	22.5	27.3
50	28.0	29.6	29.1	32.0
100	20.3	31.8	35.1	30.5
150	24.8	35.8	32.5	31.8
Dried leaf rate (%)				
N Dosages (kg / ha)	P_2O_5 Dosages (kg/ha)			
	0	40	80	120
0	55.6	47.2	49.4	48.9
50	55.2	49.9	52.0	50.9
100	52.3	50.3	52.5	48.8
150	44.7	42.5	44.2	40.1

*P<0.05

further observed that number of sterile tillers increased at low N and P fertilisation (data not shown). Maximum dried leaf rate was obtained with no fertiliser application. However, the application of P 2O5 and N did not affect dried leaf matter yield statistically. Irrespective of the dose of N & P_2O_5 their effect on leaf formation was inconspicuous. The results do not agree with Bowns (1971) who reported that the application of phosphorus increases the uptake of nitrogen. Similarly Smika *et al.* (1969) indicated that the application of P resulted in a more efficient use of N by range of grass species. The results indicate that N is positively efficiently used to have a positive effect on plant height.

The highest protein from the stem segments and leaves was obtained when fertilized with 150 kg N ha^{-1} (Table III & IV). Contrarily, P irrespective of dose negatively affected the protein content of stem segment. Bowns (1971), obtained the highest protein contents with the application of nitrogen alone or in combination with P in various range grasses. This contrast could be due to the difference of grass species used. Protein content drastically reduced at the second clipping irrespective of the dose of N or P (Table III & IV). This is possibly due to the faster maturity of leaves and stems which prevents protein accumulation caused by the warmer climate and increased day-length during the second clipping. Berg (1990) recommended 105 kg N ha^{-1} yr^{-1} for Old World bluestem in years with greater precipitation. This recommendation is in harmony with our results.

Under intensive grazing it is important to allow sufficient forage growth before the start of grazing begins (Gillen & Berg, 1998). Misapplications at early grazing could degenerate rangeland and also shorten the grazing period. An appropriate fertilization may provide more resistant forage at the beginning of grazing. Berg (1993) recommends application of nitrogen 3 to 4 weeks after grass green up which causes results in greater herbage yield, especially when urea is used. Fertilizer responses vary with geographical location, type of vegetation and precipitation. Fertilizer applications should be designed for different ecological regions combined with the other range management methods for efficient grazing during great

Table III. The effect of nitrogen (N) and phosphorus (P) fertilizer dosages on the protein content of Yellow Bluestem (*Bothriochloa ischaemum* stems for two clipping

Nitrogen Dosages (kg/ha)	P_2O_5 Dosages (kg/ha) 0				40				80				120				P<0.05
	1st		2nd		1st		2nd		1st		2nd		1st		2nd		
0	5.5	cf*	2.5	h	5.0	eg	2.5	h	5.1	dg	1.8	h	4.6	fg	2.2	h	
50	4.6	fg	2.3	h	4.2	g	2.0	h	4.9	efg	2.1	h	5.6	cf	1.7	h	
100	6.4	bc	2.1	h	5.4	cf	1.9	h	5.3	dg	2.0	h	5.4	cf	1.7	h	
150	8.0	a	2.4	h	6.9	b	1.8	h	5.7	cde	1.8	h	6.1	bcd	2.0	h	

Table IV. The effect of nitrogen (N) and phosphorus (P_2O_5) fertilizer dosages on the protein content of Yellow Bluestem (*Bothriochloa ischaemum* L.) leaves for two clipping

Nitrogen Dosages (kg/ha)	P_2O_5 Dosages (kg/ha) 0				40				80				120				*P<0.05
	1st		2nd		1st		2nd		1st		2nd		1st		2nd		
0	11.3	cd*	5.5	h	9.4	g	5.3	h	5.1	h	5.0	h	9.7	efg	5.0	h	
50	10.5	dg	5.6	h	9.4	fg	4.7	h	10.6	dg	5.2	h	11.5	bcd	4.2	h	
100	12.9	bc	5.6	h	11.1	cf	4.6	h	11.8	bcd	4.4	h	11.7	bcd	3.8	h	
150	15.5	a	4.3	h	13.1	b	3.9	h	12.1	bcd	4.1	h	11.3	cde	4.2	h	

number of years.

In conclusion the result suggested that 150 kg N ha^{-1} was optimum for most of the investigated characters. The protein content of forage is the key for animal nutrition and forage must contain higher protein content for recombination to a range dominated by such a grass. Phosphorus has little effect on yield but, as mentioned above, it increases the uptake of nitrogen.

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