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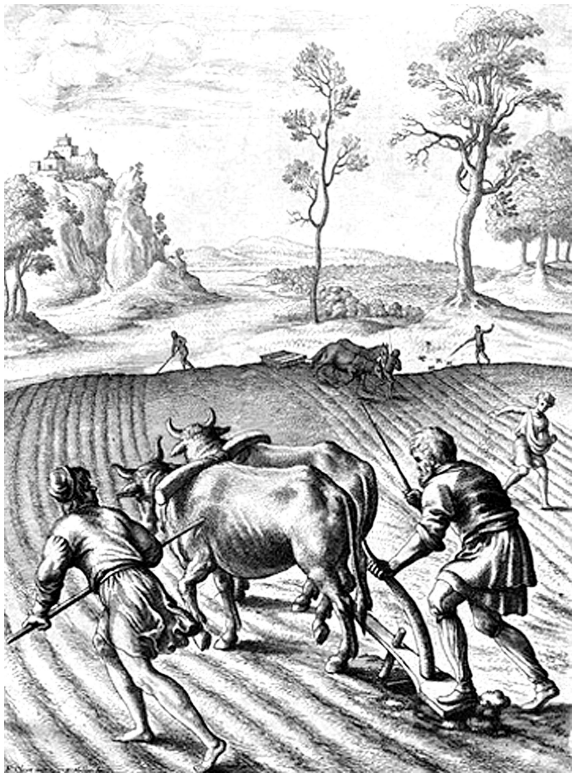

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Effects of Different Levels and Application Times of Humic Acid on Root and Leaf Yield and Yield Components of Forage Turnip (*Brassica rapa* L.)

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Abstract: The effects of four humic acid levels (0, 600, 1200 and 1800 mL ha^{-1}) and three application times (after emergence onto leaves, after 1 month of sowing date onto leaves and after 2 month of sowing date onto leaves) on root and leaf yields and some yield components of forage turnip were evaluated under the Black Sea Coastal Area Conditions, Turkey in the 2003 and 2004 growing seasons. The root yield, root dry matter yield, root crude protein yield, root diameter, root length, leaf yield, leaf dry matter yield and leaf crude protein yield were determined. Humic acid significantly affected most of the yield components determined in forage turnip. Root and leaf yields and their yield components increased along with increase of humic acid. The highest root and leaf dry matter yields were obtained from the 1200 mL ha^{-1} humic acid level and second application time. Forage turnip gave the greatest response to humic acid application in terms of yield and yield components under the Black Sea Coastal Area Conditions, Turkey.

Key words: Forage turnip, humic acid, application time, root yield, leaf yield

INTRODUCTION

Brassica species have been long known for their use as forage crops in much of the world. They are high quality, high yielding, fast growing crops that are suitable for livestock grazing. Most *Brassicas* are relatively low in dry matter content, but their total dry matter production per unit area is high relative to most cereals and forage grasses[1]. The dry matter of 4 to 8 t ha^{-1} have been reported[1-5] for *Brassica* ssp. The crude protein content was higher in leaves of forage turnip than in roots, but roots accumulated more NO_3 than leaves[6].

Humic Acid (HA) is one of the major components of humus. Humates have long been used as a soil conditioner, fertilizer, soil supplement. Humates are natural organic substances, high in humic acid and containing most of known trace minerals necessary to the development of plant life[7]. Humus holds not just micronutrient metal ions, but also the essential macronutrients: nitrate, phosphate and potassium. Recent research showed that humic acid can be used as a growth regulator to regulate hormone level, improve plant growth and enhance stress tolerance[8]. Tan *et al.*[9] indicated that humic acid was in general beneficial to shoot and root growth of corn plants. Dry matter yield in corn shoots was stimulated by HA, especially when the plants were treated with HA at a concentration of 640 ppm. Several hypotheses have been proposed to explain the effect of HA. These include the formation of complex between HA and mineral ions, catalysis of HA to enzymes in plant, influence of HA on respiration and photosynthesis, stimulation of nucleic acid metabolism and hormone activity of HA. Recent research showed that HA, when applied to turfgrass, can stimulate shoot and root growth and improve resistance to environmental stress in turfgrass[10,11].

The objective of this research was to determine effects of different levels and application times of humid acid on yield and nutritional value of forage turnip (*Brassica rapa* L.).

MATERIALS AND METHODS

Field studies were conducted at Black Sea Agricultural Research Institute (15 km east of Samsun, Turkey) in an area of the Çarşamba plain (elevation 4 m). The experiments were carried out during two growing seasons (2003 and 2004) on clay-loam soil. Soil pH was 7.08; organic matter 2.13 g kg^{-1}; available P, 19 g kg^{-1}; available K, 91 g kg^{-1}. The monthly rainfall for July through October was 37.7, 3.4, 94.4 and 194.7 mm in 2003 (330.2 mm total) and 68.1, 14.6, 66.2 and 83.4 mm in 2004 (232.3 mm total). The 27-year mean for the same months is 201.1 mm and the full-year mean is 705 mm. Forage turnip

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(*Brassica rapa* L.) cultivar (tetraploid Volenda) were obtained from Field Crops Department Agricultural Faculty of the Ankara University.

Factorial arrangements of four humic acid levels (0, 600, 1200 and 1800 mL) and three application times (after emergence onto leaves, after 1 month of sowing date onto leaves and after 2 month of sowing date onto leaves) were evaluated in a randomized complete block design with three replications. Fertilizer applied before seeding in 2003 and 2004 provided 50 kg N ha^{-1} in all plots. Seeding rates were 8 kg ha^{-1}. Individual plot size was 2.4x4 m= 9.6 m^2. Sowing was done by hand on 8 and 7 July in 2003 and 2004, respectively. Plots were irrigated four times through experiments in every year. 10 plants from each replication were taken at harvest stage for morphological measurements. Root diameter and root length were measured from individual plants. Plots were harvested on 8 and 12 October in 2003 and 2004, respectively. After harvest, fresh yields of leafs and roots were determined separately and samples were dried in ovens at 70°C to a constant weight for dry matter content[12]. Dried samples were grounded and the amount of N was found by using kjehldal method. Amount of N from each sample was multiplied by 6.25 and the crude protein content was calculated. Fresh yield obtained from each plot, dry matter and crude protein contents were calculated as fresh, dry matter and crude protein yields per hectare. All statistical analyses were conducted using GLM producers of SAS[13]. The data in 2003 and 2004 were analyses together. Means were compared using Least Significant Difference (LSD) test at the 0.05 probability level.

RESULTS AND DISCUSSION

The forage turnip differed in their response to HA and AT treatments. The highest root and leaf yields were obtained from 1200 mL HA dose and after 1 month of sowing date onto leaves (second application time). The 2-year average root yields from the 0, 600, 1200 and 1800 mL HA treatments were 32.44, 42.23, 50.76 and 49.39 tons ha^{-1}, respectively (Table 1). The 2-year average leaf yields from the 0, 600, 1200 and 1800 mL HA treatments were 22.62, 31.87, 35.16 and 33.34 tons ha^{-1}, respectively (Table 2). Increasing HA levels increased root and leaf yields in our study. The root and leaf yield in forage turnip varied from 15.34 to 66.57 and 24.53 to 43.47 t ha^{-1}, respectively[2,14-16]. In forage turnip, the use of HA is limited whereas Tan *et al.*[9] indicated that Humic Acid (HA) was in general beneficial to shoot and root growth of corn plants. Dry matter yield in corn shoots was

Table 1: The effects of different levels and application times of humic acid on root yield and yield components of forage turnip (average of 2 years)*

	Humic acid levels (mL ha^{-1})				
Application Times	0	600	1200	1800	mean
Root yield (t ha^{-1})					
1**	28.95*	29.65	34.60	41.21	33.60c
2	32.84	56.03	66.62	58.78	53.57a
3	35.54	41.03	51.06	48.19	43.95b
mean	32.44c	42.23b	50.76a	49.39a	43.71
LSD	Humic acid x Application times=7.55**				
Root dry matter yield (t ha^{-1})					
1	3.04	3.12	3.41	3.92	3.37c
2	3.43	5.51	6.38	5.81	5.28a
3	3.61	4.42	5.30	4.99	4.58b
mean	3.36c	4.35b	5.03a	4.91a	4.41
LSD	Humic acid x Application times=0.59**				
Root crude protein yield (t ha^{-1})					
1	0.32	0.34	0.36	0.43	0.36c
2	0.38	0.59	0.66	0.64	0.57a
3	0.39	0.48	0.58	0.53	0.49b
mean	0.36c	0.47b	0.53a	0.53a	0.47
LSD	Humic acid x Application times=0.07**				
Root diameter (cm)					
1	5.43	5.30	6.03	6.80	5.89b
2	6.10	7.22	7.50	7.08	6.97a
3	6.14	6.20	6.34	6.30	6.25b
mean	5.89c	6.24bc	6.62ab	6.73a	6.37
LSD	Humic acid x Application times=0.73*				
Root length (cm)					
1	10.90	12.15	13.41	14.10	12.64b
2	11.42	14.53	15.02	14.46	13.86a
3	12.23	13.68	14.27	12.90	13.27ab
mean	11.52b	13.45a	14.23a	13.82a	13.25
LSD	Humic acid x Application times=1.41*				

*Means in the same column followed by the same letter(s) were not significantly different at the 0.05 level

**1) after emergence onto leaves, 2) after 1 month of sowing date onto leaves 3) after 2 month of sowing date onto leaves

Table 2: The effects of different levels and application times of humic acid on leaf yield and yield components of forage turnip (average of 2 years)*

	Humic acid levels (mL ha^{-1})				
Application Times	0	600	1200	1800	mean
Leaf yield (t ha^{-1})					
1**	18.02*	17.79	26.52	26.97	22.32c
2	25.70	41.78	48.05	41.23	39.19a
3	24.14	36.03	30.92	31.81	30.72b
mean	22.62c	31.87b	35.16a	33.34ab	30.73
LSD	Humic acid x Application times=5.49**				
Leaf dry matter yield (t ha^{-1})					
1	2.11	2.35	3.29	3.61	2.84c
2	3.28	5.37	6.02	5.47	5.03a
3	3.31	4.67	4.00	3.92	3.98b
mean	2.90b	4.13a	4.44a	4.33a	3.95
LSD	Humic acid x Application times=0.81**				
Leaf crude protein yield (t ha^{-1})					
1	0.27	0.32	0.47	0.55	0.40c
2	0.48	0.85	0.94	0.81	0.77a
3	0.49	0.72	0.61	0.57	0.59b
mean	0.41b	0.63a	0.67a	0.65a	0.59
LSD	Humic acid x Application times=0.16**				

*Means in the same column followed by the same letter(s) were not significantly different at the 0.05 level

**1) after emergence onto leaves, 2) after 1 month of sowing date onto leaves 3) after 2 month of sowing date onto leaves

stimulated by HA, especially when the plants were treated with HA at a concentration of 640 ppm. Present findings are in agreement with the results of Tan *et al.*[9].

The highest root and leaf dry matter yields were obtained from 1200 mL HA level (6.38 and 6.02 t ha^{-1}, respectively) in second application time (Table 1 and 2). The dry matter yields of 4 to 8 t ha^{-1} have been reported[1-5,17] for *Brassica* ssp. Karakaya and Altınok[14] obtained 2.42 and 4.56 t ha^{-1} root and leaf dry matter yields from forage turnip. Griffin *et al.*[18] indicated that root+leaf dry matter yield varied from 1.18 to 5.07 t ha^{-1} in forage turnip. Similar findings were found in our research.

The 0, 600 and 1800 HA levels produced significantly less root and leaf crude protein yields in all HA levels when compared with the 1200 mL HA level. In addition, The highest root and leaf crude protein yields were obtained from second application time. The 2-year average root crude protein yields from the 0, 600, 1200 and 1800 mL HA treatments were 0.36, 0.47, 0.53 and 0.53 tons ha^{-1}, respectively. The 2-year average leaf crude protein yields from the 0, 600, 1200 and 1800 mL HA treatments were 0.41, 0.63, 0.67 and 0.65 tons ha^{-1}, respectively. Of more importance to the producer is that quality of brassica herbage is more comparable to a concentrate than traditional forage because of the relatively low fiber and high protein content[19]. Jung *et al.*[3] reported that crude protein yields in forage turnip were 1.54 and 2.01 t ha^{-1} in root and leaf, respectively. Karakaya and Altınok[14] obtained 0.82 and 1.00 t ha^{-1} root and leaf crude protein yields from forage turnip.

The 2-year average root diameters from the 0, 600, 1200 and 1800 mL HA treatments were 5.89, 6.24, 6.62 and 6.73 cm, respectively. The 2-year average root diameters from the first, second and third application time were 5.89, 6.97 and 6.25 cm, respectively. Increasing HA levels, root diameter also increases in forage turnip. Increasing HA levels, root length also increases in forage turnip, just like the root diameter (Table 1). The 2-year average root length from the 0, 600, 1200 and 1800 mL HA treatments were 11.79, 12.26, 13.02, 13.89 and 13.04 cm, respectively. The highest root length was found 15.02 cm in 1200 mL HA treatments in second application time. It was previously reported that root diameter and root length in forage turnip ranged from 5.13 to 9.07 cm and 9.75 to 40.86 cm, respectively[15,20,21].

In summary, the highest root and leaf dry matter yields were obtained from the 1200 mL HA levels and second application time. Forage turnip gave the greatest response to HA application in terms of yield and yield components under the Black Sea Coastal Area Conditions, Turkey. It is possible to obtain high root and leaf yield from the forage turnip by using HA instead of over Nitrogen fertilization. So, environment and soil pollution may be reduced, beside it may be avoided high fertilizer input.

REFERENCES

1. Rao, S.C. and F.P. Horn, 1986. Planting season and harvest date effects on dry matter production and nutritional value for *Brassica* ssp. in the southern great plain. Agron. J., 78: 327-333.
2. Albayrak, S., N. Çamaş and C.S. Sevimay, 2004. The influence of row spacing on root and leaf yields and yield components of forage turnip (*Brassica rapa* L.). Turkish J. Field Crops, 9: 72-77.
3. Jung, G.A., R.A. Byers, M.T. Panciera and J.A. Shaffer, 1986. Forage dry matter accumulation and quality of turnip, swede, rape, Chinese hybrids and kale in the eastern USA. Agron. J., 78: 245-253.
4. Jung, G.A., W.L. McClellan, R.A. Byers, R.E. Kocher, L.D. Hoffman and H.J. Donley, 1983. Conservation tillage fo forage *Brassica*. J. Soil Water Conserve, 38: 227-230.
5. Kalmbacher, R.S., P.H. Everett, F.G. Martin and G.A. Jung, 1982. The management of brassica for winter forages in the sub-tropics. Grass Forage Sci., 37: 219-225.
6. Pelletier, G.E., E. Donefer and J.P.F. Darisse, 1976. Effects of dates of seeding and levels of N fertilization on yields, chemical composition an *in vitro* digestibility of forage kale. Can. J. Plant Sci., 56: 63-70.
7. Senn, T.L., 1991. Humates in Agriculture. Acres USA, Jan.
8. Piccolo, A., S. Nardi and G. Concheri, 1992. Structural characteristics of humic substances as regulated to nitrate uptake and growth regulation in plant systems. Soil Biol. Biochem., 24: 373-380.
9. Tan, K.H. and V. Nopamornbodi, 1979. Effects of different levels of humic acids on the nutrient content of corn (*Zea mays*). Plant and Soil, 51: 283-287.
10. Schmidt, R.E., 1990. Employment of biostimulants and iron for enhancement of turfgrass growth and development. Proceeding of 30th Virginia Turfgrass Conference.
11. Goatley, J.M. Jr. and R.E. Schmidt, 1990. Anti-senescence activity of chemicals applied to Kentucky bluegrass. J. Amer. Soc. Hort. Sci., 115: 57-61.
12. Martin, R.C., H.D. Voldeng and D.L. Smith, 1990. Intercropping soybean for silage in a cool temperate region: Yield, protein and economic effects. Field Crops Research, 23: 295-310.

13. SAS Institute, 1998. INC SAS/STAT Users' Guide Release 7.0, Cary, NC, USA.
14. Karakaya, A. and S. Altınok, 2002. Forage yield and quality of different turnip cultivars grown as main and second crop under Ankara conditions. Turkish J. Field Crops, 7: 67-72.
15. Mülayim, M., R. Acar and Y.Z. Atalay, 1996. The effects of plant densities and harvesting timrs on root yield of forage turnip as a second crop in Konya. Selçuk University. J. Agric. Fac., 10: 141-151.
16. Uzun, A., 1990. Investigations on yield and quality of turnip grown as a second crop under Bursa conditions. MS Thesis, Uludağ University,
17. Wiedenhoeft, M.H., 1993. Management and environment effects on dry matter yields of three *Brassica* species. Agron. J., 85: 549-553.
18. Griffin, J.L., G.A. Jung and N.L. Hartwig, 1984. Forage yield and quality of *Brassica* sp. established using preemergence herbicides. Agron. J., 76: 114-116.
19. Wiedenhoeft, M.H. and B.A. Barton, 1994. Management and environment effects of brassica forage quality. Agron. J., 86: 227-232.
20. Beşpınar, A.T., 2003. Effects of plant density on forage yield and quality of forage turnip grown under Ankara conditions. MS Thesis, Ankara University.
21. Atalay, Y.Z., 1997. The effect of different plant densities on yield and yield components on turnip as a second crop under irrigated conditions. MS Thesis, Selçuk University.