IMPACT OF GRAZING ON YIELD OF *CICHORIUM INTYBUS* L.

Megha Bhambri
Dept. of Botany, Dada Ramchand Bakhru Sindhu Mahavidyalaya/ RTMNU, Nagpur, Maharashtra, India.

ABSTRACT
Cichorium intybus L. is of immense medicinal value. It belongs to family Asteraceae. It is best known for its use as caffeine free coffee substitute. Chicory is very palatable to animals in general and farm animals in particular. Chicory can be grown as a root crop, as a salad or vegetable crop, seed crop or as an herbage crop due to its multipurpose utility. The high palatability, high digestibility to herbivores causes a problem when it is grown especially for root or seed production. An experiment was designed to assess the need of grazing control. It was observed that the differences in the mean values among the protected and unprotected plots were significant for the root yield. Hence it can be stated that the grazing significantly reduces the crop yield of Cichorium intybus L.

KEYWORDS :- *Asteraceae, Caffeine, Cichorium intybus L., Grazing, Palatable.*

INTRODUCTION

Cichorium intybus is a plant of immense medicinal importance. It belongs to family Asteraceae which is the largest plant family. The Genus name *Cichorium* is derived from the ancient Arabic word Chikourych, which was the name for a species of salad vegetable, for chicory [1]. Common names for *Cichorium intybus* L. are Chicory; succory; blue sailor; coffee weed; and witloof (Quattrocchi, 2000). Chicory, (*Cichorium intybus* L.) has originated in the Mediterranean, Central Asia and Northern Africa. Cultivation of this plant has been reported as early as the ancient Roman and Greek eras [1, 2]. Historically, chicory was grown by the ancient Egyptians as a medicinal plant, coffee substitute [3]. The first mention of chicory cultivation was in 1616, in Germany. In India chicory is found in the north- western regions like Kashmir and Punjab and in areas of South India.

Chicory is one of the most promising novel plant candidates among the carbohydrates with a potential for utilization in both food and non-food products [4, 5]. Four thousand years ago, chicory roots were used as a substitute for coffee in ancient Egypt [6, 7]. It is perhaps best known for the roasted roots used as the traditional coffee substitute with no caffeine and less well known as grazed forage for ruminants [8].

Various health benefits particularly of the roots of the plant found widespread application in traditional medicines in different parts of the world. The aqueous root extract is used against malaria in Afghanistan [9]; for the treatment of warts in Iran [10]; against liver diseases and digestion problems in Poland [11]; as laxative and diuretic in Italy and Serbia [12, 13,14]; the poultice prepared from the roots is used for pain relief in Pakistan [15]. Like Turkey, the dried root of plant is also used to prepare coffee-like beverages and as stomachic in Belgium, France and USA [12]. On the other hand, the aqueous extract from the seeds is employed against liver diseases and diarrhea in India[16], while the fresh shoots are consumed as food and utilized for the treatment of urinary infections and stomach ache [16].

Chicory is very palatable to animals in general and farm animals in particular. It is grown as a major fodder crop alongside leguminous plants in Europe and Americas. Where chicory is grown for roots, grazing adversely affects the vegetative growth (Plate 1 and 4) and root yield (Plate 2 and 5) in the same manner as diseases affects the crop yield of some important medicinal plants like aphids in *Ammi majus* L. [17]. It becomes extremely difficult to manage Chicory from grazing as all type of herbivores starting with goats, cows to squirrels and rabbits that were digging the roots out attacked the crop. An experiment was designed to assess the need of grazing control.

MATERIALS AND METHODS

2.1 Experimental Site

The present experiment was carried out at the Farm located at Gorewada, Nagpur (M.S.) to assess the need of grazing control by growing chicory in protected and unprotected plots.

2.2 Experimental Design

The experimental field (Farm) was divided into 20 plots of $2m^2$. The field was divided into 4 blocks, each block having five plots. A randomized Block Design (RBD) plan was followed for the layout. The plots within a block were selected randomly and marked for the treatment types.

2.3 Collection of seed material

Seed material for cultivation of *C. intybus* L. was purchased from "Spring Haven" Jamnagar, India.

2.4 Preparation of field and sowing

For cultivation the field was ploughed to clear off the weeds and also for polarization of the underneath soil layer to get rid of the unwanted soil fungal flora. The soil used in the experiment was sandy loam. The field was ploughed to a fine tilth. Farmyard manure of well-rotted compost at the rate of 10-12 q/hectare was added to prepare the plots. Basal fertilizers N: P: K and a basal dose of 120 kg/ha Neem and Mustard cake was incorporated.

For sowing *Cichorium intybus*, seeds are sown in a fine-textured seed bed, at a depth of 1 cm in rows spaced 25-30 cm apart. Seed were sown by broadcasting at the rate of 2 kg/hectare. The seed start germinating within 3 to 10 days after sowing. When plants reach the 3rd leaf stage they are thinned to stand 15 -20 cm apart in the row. Thinning should not be too late, as thinning may disturb roots of remaining plants.

2.5 Irrigation

Maintenance of moisture plays a major role in growth of this crop. Hence, irrigation frequency is to be matched according to water retention of soil. Periodic watering was done preferably in the evening around 4 o'clock to keep the soil appropriately moist.

2.6 Weeding

The care is to be taken to control the growth of weeds during initial period of growth and hence, 2-3 weeding are to be carried out. Two hoeing followed by manual weeding saves labour and also keeps soil loose and moist, allows aeration to roots and prevents hardening of the soil.

2.7 Collection of Data for Morphological studies

Various Crop yield parameters of *Cichorium intybus* were scored based on 25 plants selected randomly per replicate per treatment. The observations were done after 6 months of sowing in terms root length; diameter of the root at root top, root fresh weight, root dry weight, biomass of the plant and crop yield $/m^2$.

RESULT AND DISCUSSION

The plants of *Cichorium intybus*, during this experiment were scored for yield (under ground part) related parameters presented in Table 1 and Fig. 1 and 2. It becomes evident that crops grown at both locations have significantly varied due to the impact of grazing.

The parameters measured are root length; diameter of the root at root top, root fresh weight, root dry weight, biomass of the plant and crop yield $/m^2$. The pattern of various crop (root) yield parameters of the two treatment types can be expressed as follows:

Variation in mean root length in cm due to the effect of grazing

T_2 (28.377) > T_1 (18.735)

There is a decrease of 33.97% in mean root length in T_1.

Variation in mean root diameter at root top in cm due to the effect of grazing

T_2 (12.035) > T_1 (9.325)

There is a decrease of 22.52% in root diameter top in T_1.

It is obvious from the above results that grazing in unprotected location has influenced and has caused significant reduction in the root length and root diameter of roots of chicory.

Root weight is an important parameter as it is the part of economic importance. Roots of randomly selected plants were harvested and their fresh weight and dry weight was determined from each treatment type. The data is tabulated Table 1 and Fig. 1. Maximum mean fresh weight of root /plant (525.940 gm) was recorded in taxa of treatment type T_2 while minimum mean fresh weight/plant (409.517gm) was recorded for treatment type T_1. The sequence of root fresh weight for the two treatments can be written as follows
Variation in mean root fresh weight/plant in gm due to the effect of grazing is
T_2 (525.940) > T_1 (409.517)

There is a decrease of 35.71% in mean fresh weight of root in T_1.
On perusal of data presented in Table 1 and Fig. 2. It becomes evident that grazing has significantly affected the root weight of the plants.

Maximum mean dry weight (143.39 gm) of root was recorded in taxa of treatment type T_2 while minimum mean dry weight (102.379 gm) of root was recorded for treatment type T_1. The sequence of root dry weight for the two treatments can be written as follows:
Variation in mean root dry weight in gm due to the effect of grazing is
T_2 (143.392) > T_1 (102.379)

There is a decrease of 47.22% in mean dry weight of roots in T_1.
On perusal of data presented in Table 1 and Fig. 2. It becomes evident that grazing has significantly affected the root weight of the treated plants.

Biomass of *Cichorium intybus* plants at the time of harvest was measured. The biomass has varied from 117.386 gm/plant (T_1) to 167.167 gm/plant (T_2). On the perusal of data it is obvious that Treatment type T_2 (protected field) and Treatment type T_1 (unprotected field) has given highly significant variation in biomass production/plant. The overall pattern of results can be expressed as follows:
Variation in biomass/plant in gm due to the effect of grazing is
T_2 (167.167) > T_1 (117.386)

There is a decrease of 45.74% in biomass of roots in T_1.
The crop (root) yield kg/m^2 of *Cichorium intybus* plants at the time of harvest was measured at the two locations. The crop (root) yield kg/m^2 has ranged between 13.514 kg/m^2 (T_1) and 17.356 kg/m^2 (T_2) On the perusal of data it is obvious that Treatment type T_2 (protected field) and Treatment type T_1 (unprotected field) have given extremely significant variation of .210kg/m^2 in root production. The overall pattern of results can be expressed as kg/m^2 as follows:
T_2 (17.356) > T_1 (13.514)

There is a decrease of 44.52% in mean crop yield in T_1.
ANOVA analysis reveals that grazing has shown significant difference for all the parameters analyzed at $P<0.001$. On pair wise multiple comparisons (Fisher LSD Method) it was observed that the differences in the mean values among the two treatment groups are greater than would be expected by chance; indicating a statistically significant difference in case of root length, Fresh and dry weight of root and biomass. Hence it can be stated that the grazing significantly affects adversely on all parameters related to crop yield *of C. intybus.*

Plate No. 1
***C.intybus* L. Vegetative growth**

Plate No. 2
***C. intybus* L. Root length**

Plate No. 3
***C. intybus* L. Dried root cubes**

PROTECTED FIELD

Plate No. 4
***C.intybus* L. Vegetative growth**

Plate No. 5
***C. intybus* L. Root length**

Plate No. 6
***C. intybus* L. Dried root cubes**

UNPROTECTED FIELD

3. Figures & tables

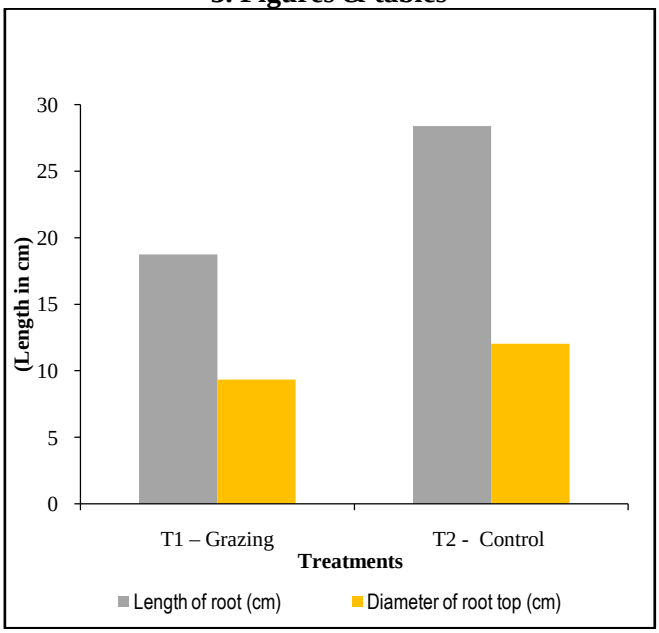

Figure 1 - Effect of grazing on length and diameter of *Cichorium intybus* l.

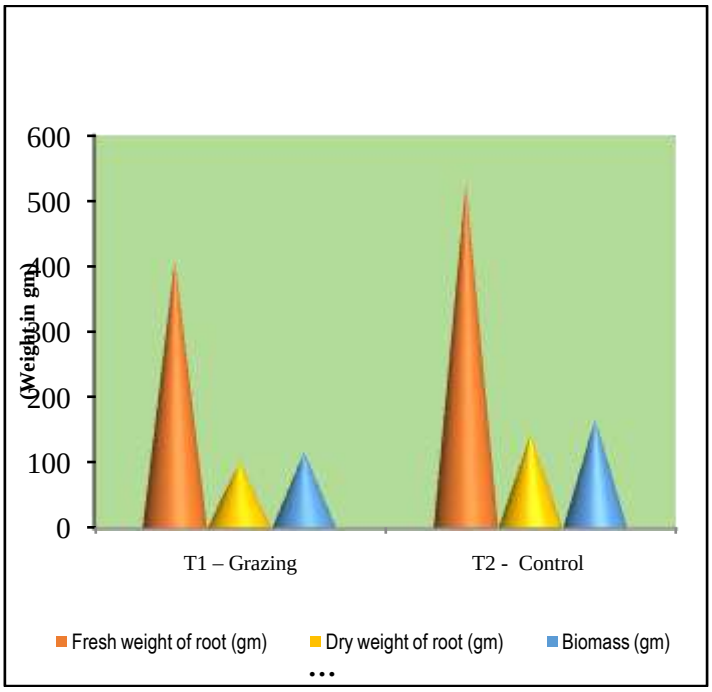

Figure 2 - Effect of grazing on crop yield of *Cichorium intybus* L.

Table 1 Effect of grazing on root (crop) traits and crop yield of *Cichorium intybus* L.

Sr. No.	Treatment	Stats	Length of root (cm)	Diameter of root top (cm)	Fresh weight of root (gm)	Dry weight of root (gm)	Biomass	Crop yield kg/m^2
1.	**T_1**(Grazing)	$\bar{x}$	18.735	9.325	409.517	102.379	117.386	13.514
		S_D	1.239	3.975	15.873	7.152	4.116	4.875
		S_{ER}	0.619	1.867	7.936	3.577	2.058	2.437
2.	**T_2**(Control)	$\bar{x}$	28.377	12.035	525.940	143.392	167.167	17.356
		S_D	0.638	3.112	5.414	1.816	1.200	4.532
		S_{ER}	0.319	1.558	2.707	0.908	0.600	2.266
3.	**% decrease in T_1**		33.97	22.52	35.71	47.22	45.74	44.52
4.	**LSD at 5%**		1.705		20.518	9.028	5.245	

CONCLUSION

Chicory is a relatively new forage crop [18]. Chicory produces leafy growth which if managed properly is similar in nutritive value of Lucerene, *Medicago sativa* L., [19], but the mineral content is superior for copper and zinc. Its forage is highly palatable to livestock [20, 21]. It has higher concentrations of minerals relative to grasses & legumes [22, 23, 21]. Currently, forage chicory is being studied for its bio-active compounds, such as tannins or sesquiterpene lactones, which can reduce nematode and helminthic parasitic infection in animals [24, 25, 26, 27, 28]. Forage chicory is a valuable pasture component because it exhibits more tolerance to adverse environmental conditions such as drought [29], low soil fertility and disease and pest resistance [30]. It is highly pest resistant and high yielding plant that can improve seasonal distribution of high quality herbage to both poultry and live- stock [31, 29].

Due to above mentioned facts chicory is a favorite herbage crop exclusively or in mixed cropping with other pasture leguminous plants or grasses in west. As mentioned earlier, chicory can be grown as a root crop, as a salad or vegetable crop, seed crop or as an herbage crop due its multipurpose utility. The high palatability, high digestibility to herbivores causes a problem when it is grown especially for root or seed production.

Utmost appropriate grazing management is required so that the root yield is not affected. Hence it is very important to keep proper care and arrangement to save the crop from herbivores like any other root crop.

REFERENCES

[1] U. Quattrocchi, *CRC World Dictionary of Plant Names, p. 538, (CRC Press LLC, New York, NY, 2000)* .

[2] W. Plmuier, Chicory improvement, *Revueder Agriculture, 4, 1972, 567–585.*

[3] Q. Wang & Cui J, A review on pharmic effect of chicory (*Cichorium intybus* L.) research and development. *China. J. Chinese Materia Medica, 34, 2009a, 50-53.*

[4] Wang, Quanzhen & Cui Jian, Perspectives and utilization technologies of chicory (*Cichorium intybus* L.), *African Journal of Biotechnology, 10(11), 2011, 1966-1977.*

[5] H.A. Hassan & M.I.Yousef, Ameliorating effect of chicory (*Cichorium intybus* L.)-supplemented diet against nitrosamine precursors-induced liver injury and oxidative stress in male rats, *Food Chem Toxicol, 48, 2010, 2163–2169.*

[6] J. Deshusses, The content of formic acid in roasted coffee, chicory, soluble extracts of coffee and coffee substitutes, *Mitt GebLebensmittelunters Hyg, 52, 1961, 428–30*.

[7] C. Van Waes, J. Baert, L. Carlier & E. Van Bockstaele, A rapid determination of the total sugar content and the average inulin chain length in roots of chicory (*Cichorium intybus* L), *J Sci Food Agri., 76, 1998, 107–110.*

[8] M.S. Barbara, I. Nebojsa, P. Alexander & R. Ilya, Toxicological evaluation of a chicory root extract, *Food and Chemical Toxicology 45, 2007, 1131-1139.*

[9] A.T. Bischoff, C.J. Kelley, Y. Karchesy, M. Laurantos, P. Nguyen-Dinh & A.G. Arefi, Antimalarial activity of Lactucin and Lactucopicrin: sesquiterpene lactones isolated from *Cichorium intybus* L. *Journal of Ethno pharmacology, 95 (2-3), 2004, 455–457.*

[10] N.A. Syed, T.N. Hasan & SMM. Aalam, Evaluation of Wound Healing Potential of *Cichorium intybus*. L (Asteraceae) in rats, *Iranian Journal of Pharmacology and Therapeutics,7, 2008, 181–184.*

[11] W. Kisiel & K. Michalska, A new coumarin glucoside ester from *Cichorium intybus*, *Fitoterapia , 73, 2002, 544–546.*

[12] N. Mulinacci, M. Innocenti, S. Gallori, A. Romani, G. LaMarca & F. Vincieri, Optimization of the chromatographic determination of polyphenols in the aerial parts of *Cichoriumi ntybus* L., *Chromatographia, 54, 2001, 455–461.*

[13] J. Petrovic, A. Stanojkovic, L.J. Comic & S. Curcic, Antibacterial activity of *Cichorium intybus*, *Fitoterapia, 75 (7-8), 2004, 737-739.*

[14] P.N. Pushparaj, H. K. Low, J. Manikandan, B.K.H. Tan & C.H.Tan, Antidiabetic effects of *Cichorium intybus* in streptozotocin-induced diabetic rats, *J. Ethnopharmacol, 111, 2007, 430-434.*

[15] S.R.U. Shah, G. Hassan, A. Rehman & I. Ahmed, Ethnobotanical study of wild flora of District Musakhel and Barkhanin Balochistan Pakistan, *Journal of Weed Science Research, 12, 2006, 199–211.*

[16] Chhaya Gadgoli & S. H. Mishra, Antihepatotoxic activity of *Cichorium intybus*, *Journal of Ethnopharmacology, 58(2), 1997, 131–134.*

[17] M. Bhambri, A. Bajaj & K. J. Cherian, An Ecofriendly Managements of Aphid Infestation in *Ammi majus* L., *Bionano Frontier, 8(1), 2015, 37- 41.*

[18] Ryder, Lettuce, Endive, and Chicory, CABI Publishing, New York, NY, 1999, pp. 3-12, 37-52, 69, 89-90, 116, and 170.

[19] G.N. Milne, S.C. Moloney & D. Smith, Demonstration of dryland species on 90 east coast North Island farms. *Proceedings of the NZ Grassland Association SS, 1993.*

[20] H. Gao & M. Ma, Introduction and Culture of *Cichorium intybus* L. J.Grassland of China 12: 14-16, (1991).

[21] H. Li, G. Zhang & P. Guo, Study on Introduction and Culture of PunaChicory (*Cichorium intybus* L), *Bulletin of Soil and Water Conservation 26, 2006, 50-52.*

[22] D.P. Belesky, J.M. Fedders, K.E.Turner & J.M. Ruckle, Productivity, botanical composition, and nutritive values of swards including forage chicory, *Agron. J. 91, 1999, 450–456.*

[23] D.P. Belesky, K.E.Turner, J.M. Fedders & J.M. Ruckle, Mineral composition of swards containing forage chicory, *Agron. J. 93, 2001, 468– 475.*

[24] S.O. Hoskin, T.N. Barry, P.R. Wilson, W. A. G.Charleston, & J. Hodgson, Effects of reducing anthelmintic input upon growth of young fanned deer grazing chicory (*Cichorium intybus*) and perennial ryegrass (*Lolium perenne*)/white clover (*Trifolium repens*) pasture, *Journal of Agricultural Science, Cambridge, (1999a).*

[25] S.O. Hoskin, T.N. Barry, P.R. Wilson, W. A. G Charleston & G.C. Waghorn, Effect of forage legumes containing different concentrations of condensed tannins on establishment of internal parasites in young red deer. *Journal of Agricultural Science, Cambridge, (1999b) (In press.).*

[26] S.O. Hoskin, W.R. Pomroy, I. Reijrink, P.R. Wilson & T.N. Barry, Effect of with holding anthelmintic treatment on autumn growth and internalparasitism of weaner deer grazing perennial ryegrass-based pastureor chicory, *Proc. New Zealand Soc. Anim. Prod. 63, 2003, 269-273.*

[27] C.L. Marley, R. Cook, R. Keatinge, J. Barrett & N.H. Lampkin, The Effect of Birdsfoot Trefoil (Lotus Corniculatus) and Chicory (*Cichorium intybus*) on Parasite Intensities and Performance of Lambs Naturally Infected with Helminth Parasites, *Vet Parasitol, 112 (1-2), 2003, 147 – 55*.

[28] S. Athanasiadou, D. Gray, D. Younie, O. Tzamaloukas, F. Jackson & I. Kyriazakis, The use of chicory for parasite control in organic ewes and their lambs, *Parasitol. 134, 2007, 299-307.*

[29] D.R. Kemp, D.L. Michalk & M. Goodacre, Productivity of pasture legumes and chicory in central New South Wales, Aust. J. Exp. Agric.42, 2002, 15-25.

[30] J.D. Ge, The Effect of CTK on Chicory OG02 Growth and Forage Quality. M Sc thesis, *Yang Zhou University of China, Yang Zhou, P.R.China, 2006.*

[31] J. G. Foster, J.M. Fedders, W.M. Clapham, J.W. Robertson, D.P.Bligh & K.E. Turner, Nutritive value and animal selection of forage chicory cultivars grown in central Appalachia. *Agron. J. 94, 2002, 1034-1042.*

