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EVALUATION OF CHICORY (*CICHORIUM INTYBUS*) ELITE GENOTYPES FOR SEED YIELD UNDER SEMI-ARID CONDITIONS OF HARYANA

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SUMMARY

Present study was carried out by using 21 genotypes of chicory (*Cichorium intybus*) during **Rabi** 2017-18 and 2018-19 at Research Farm of MAP Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar. The results on seed yield (kg/ha) revealed that the year 2018-19 was most favourable for seed yield (214.44 kg/ha) as compared to 2017-18 (188.81 kg/ha). During 2017-18, HCI-3 was highest yielder with seed yield (320.48 kg/ha) followed by HCI-16 (311.49 kg/ha), HCI-4 (284.29 kg/ha), HCI-19 (271.81 kg/ha) and HCI-20 (266.07 kg/ha). During 2018-19, HCI-16 with 318.49 seed yield (kg/ha) was the top performing genotype followed by HCI-3 (312.94 kg/ ha), HCI-1 (292.71 kg/ha), HCI-20 (235.16 kg/ha), HCI-5 (231.49 kg/ha) and HCI-14 (227.77 kg/ha). During 2017-18, the moisture stress during early stages of plant development restricted the plant growth and development which ultimately reduced the seed yield. The evaluation of genotypes over the years exhibited that HCI -3 (316.71 kg/ha), HCI-16 (314.99 kg/ha), HCI -4 (253.34 kg/ha), HCI -20 (250.62 kg/ha) and HCI-1 (248.94 kg/ha) were the promising genotypes and need further testing over time and space before giving recommendation for commercial cultivation.

Key words : Chicory (*Cichorium intybus*), elite genotypes, seed yield, component traits

Chicory (*Cichorium intypus*) is known as *kasni* in India and it is mainly cultivated as winter green fodder crop in Haryana. Now-a-days, it is also recognized as a vegetable as well as medicinal crop. It is a perennial herbaceous semi-woody plant and belongs to family Asteraceae. It usually bears bright blue colour flowers, rarely pink or white flowers. In India, Bihar, Gujarat, Himachal. Pradesh and Tamil Nadu are leading states in chicory cultivation. It is cultivated for salad leaves, chicons or roots, which are backed, powered and used as a coffee substitute as well as food additive. It is native to Europe, West Asia, Egypt, North America, and Italy. There are many varieties of it for different uses. Vegetable commercial varieties (Bruxelles chicory, Treviso red chicory, endive) all belonging to the species intybus have remarkable economic importance. Spontaneous chicory plants are also still used for human consumption, cooked or uncooked, in some Mediterranean regions (Piluzza *et al.*, 2014).The chicory is rich in potassium (420 mg/100g) and vitamin K (297.6 mcg/100g), however; it is low in energy (22.94 Calories/100g) and protein content (1.7g/100g). It also contains vitamin A (114%), Vitamin C (40%), Vitamin B-6 (5%), magnesium (7%), iron (4%) and calcium (0.1%) of the daily recomended levels (Raulier *et al.*, 2016).

Chicory is rich in iron and dietary fibres. It controls the hunger pangs by regulating the amino acid call Ghrelin. It prevents overeating and promotes the feeling of fullness in the stomach. The presence of antioxidant and antitumor agents helps chicory to fight cancer. The laxative property of chicory alleviates the symptom of constipation. The anti-inflammatory action reduces the pain associated with arthritis. It is beneficial in conditions like muscular pains and sore joints. The laxative property of chicory leaves make it an excellent green fodder for feeding animals (Kirti and Arya, 2019). Lancioni *et al.* (2007) reported on the gastronomic / alimentary and therapeutic uses of chicory. Moreover, chicory is a spontaneous component of pasturelands, crops, and uncultivated land. It is growing as weed in forage legume crops, and occasionally used as a component of forage seed mixtures grazed in Mediterranean basin areas. Chicory is palatable for ruminants, as it is low in fiber content, and rich in nonstructural carbohydrates (Athanasiadou *et al*., 2007). According to Di Grigoli *et al*. (2012), chicory have remarked potential to provide long lasting good quality herbage and the positive effect of this species on dairy performance in grazing ewes. In addition to this, the chicory forage had less dry matter and fewer structural carbohydrates, as it can remain green longer than other forage species (Sitzia *et al*., 2006).

It is relatively slow in establishment as compared to other annual forage grasses. Once, it is established in grassland it has an excellent resistance to grazing due to its rapid regeneration capacity. Moreover, green fodder production is insufficient in the country and generally, the animals' feeds on dry straw which causes the health problems in animals. Therefore, the need is felt to feed our domestic livestock animals on medicinal plants to keep them healthy (Kirti and Arya, 2019). In Haryana, chicory seeds are generally broadcasted in raya fields during October and its seeds germinate and develop into plants and they seed up their growth just after the harvesting of raya in March and utilized as green fodder for the animals. In addition to this, it is also used for medicinal purposes. The research work on this crop is very limited. Therefore, keeping the importance and utility of this crop, present investigation was carried out to find out a suitable genotypecof chicory for cultivation in semi-arid region.

MATERIALS AND METHODS

To conduct the field experiment, 21 genotypes of Chicory (*Cichorium intybus*) were grown in RBD during **Rabi** 2017-18 and 2018-19 at Research Farm of MAP Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar located 29° 10′ N latitude and 75° 46′ E longitude with an elevation of 215.2m above the mean sea level. Weekly weather parameters data was recorded during 2017-18 and 2018-19 (Fig. 1, 2 & 3). The plot size was kept 4.0 x 0.6 m^2 with spacing 30 x 10 cm^2. The soil of experimental site was found sandy loam (Typic Ustochrepts), tested medium in organic carbon (0.46%), available nitrogen (191 kg/ha) and phosphorus (14 kg/ha) and high in available potassium (340 kg/ha). Each genotype was grown in paired rows of four meter length spacing 30 cm apart to each other. All the recommended package of practices was carried out to raise a healthy crop. Data were recorded on five randomly selected plants for Plant height (cm), number

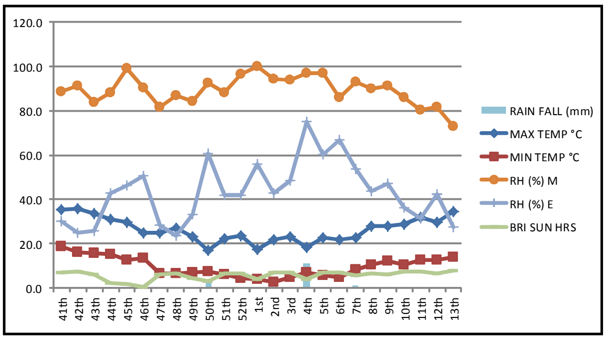

Fig. 1. Weekly weather parameters data recorded at Hisar during crop season, **rabi** 2017-18.

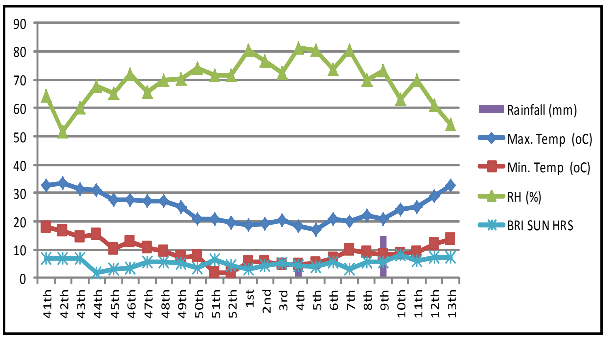

Fig. 2. Weekly weather parameters data recoded at Hisar during crop season, **rabi** 2018-19.

of branches/plant, seed yield/plot (g) and seed yield (kg/ha). The data were subjected statistical analysis as per standard procedure.

RESULTS AND DISCUSION

Plant Height (cm)

The results of field experiment are presented in table 1. The data based on overall performance on plant height (cm) exhibited that the year 2018-19 was more favourable for plant height with average height 204.13cm as compared to 2017-18 (133.97 cm). During 2017-18, HCI-6 exhibited maximum plant height 155.20 cm followed by HCI-7 (148.00 cm), HCI-11 (144.40 cm), HCI-16 (142.60cm) and HCI-5 (141.60 cm). Similarly, during 2018-19, HCI-16 (225.00 cm) was recorded as tallest genotype followed by HCI-21 (222.33 cm), HCI -13 (220.67 cm), HCI-20 (220.00 cm) and HCI-18 (216.67 cm). Average plant height over the years revealed that HCI-6 (184.10cm) was tallest and followed by HCI -16 (183.80 cm), HCI-11 (180.20 cm), HCI-13 (179.64 cm), HCI-1 (177.50 cm) and HCI-5 (177.14 cm). The availability of soil moisture directly affects the plant growth and development. During 2017-18, the plant height of all the genotypes was significantly low due to less availability of moisture in the soil profile during the early stages of growth.

TABLE 4
Performance of chicory genotypes at Hisar during 2017-18 and 2018-19

Genotypes	Plant Height (cm)			Branches/plant			Seed yield/ plot (g)			Seed yield (kg/ha)		
	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean
HCI-1	139.00	216.00	177.50	5.40	24.00	14.70	36.93	52.69	44.81	205.17	292.71	248.94
HCI-2	127.20	187.67	157.44	5.40	11.33	8.37	36.15	37.03	36.59	200.84	205.72	203.28
HCI-3	123.00	189.00	156.00	4.20	21.00	12.60	57.69	56.33	57.01	320.48	312.94	316.71
HCI-4	131.40	193.67	162.54	5.00	6.33	5.67	51.17	40.03	45.60	284.29	222.38	253.34
HCI-5	141.60	212.67	177.14	7.00	8.00	7.50	36.03	41.67	38.85	200.19	231.49	215.84
HCI-6	155.20	213.00	184.10	7.20	6.00	6.60	26.18	26.33	26.26	145.44	146.27	145.86
HCI-7	148.00	174.33	161.17	7.20	19.33	13.27	32.27	35.17	33.72	179.29	195.38	187.34
HCI-8	137.80	194.33	166.07	6.40	12.67	9.54	27.33	30.67	29.00	151.85	170.38	161.12
HCI-9	134.00	199.00	166.50	5.40	12.33	8.87	21.66	29.00	25.33	120.34	161.11	140.73
HCI-10	137.40	207.33	172.37	6.20	8.00	7.10	26.20	38.03	32.12	145.53	211.27	178.40
HCI-11	144.40	216.00	180.20	4.80	9.00	6.90	33.51	39.67	36.59	186.15	220.38	203.27
HCI-12	134.10	192.33	163.22	5.00	7.00	6.00	23.29	40.33	31.81	129.36	224.05	176.71
HCI-13	138.60	220.67	179.64	6.40	11.33	8.87	24.13	32.67	28.40	134.07	181.50	157.79
HCI-14	133.80	202.33	168.07	6.40	9.33	7.87	26.91	41.00	33.96	149.51	227.77	188.64
HCI-15	137.40	203.00	170.20	6.20	13.67	9.94	25.42	35.67	30.55	141.23	198.16	169.70
HCI-16	142.60	225.00	183.80	6.00	15.00	10.50	56.07	57.33	56.70	311.49	318.49	314.99
HCI-17	122.00	168.33	145.17	4.00	14.00	9.00	28.74	34.33	31.54	159.64	190.72	175.18
HCI-18	125.60	216.67	171.14	4.20	17.00	10.60	24.50	30.67	27.59	136.09	170.38	153.24
HCI-19	123.60	213.00	168.30	3.60	21.33	12.47	48.93	38.00	43.47	271.81	211.11	241.46
HCI-20	110.80	220.00	165.40	5.00	19.67	12.34	47.89	42.33	45.11	266.07	235.16	250.62
HCI-21	125.80	222.33	174.07	4.80	14.67	9.74	22.70	31.67	27.19	126.08	175.94	151.01
Mean	133.97	204.13	169.05	5.51	13.38	9.45	33.99	38.60	36.29	188.81	214.44	201.62
Range	110.80-155.20	168.33-225.00	145.17-184.10	3.60-7.20	6.00-24.00	5.67-13.27	21.66-57.69	26.33-57.33	25.33-57.01	120.34-320.48	146.27-318.49	140.73-316.71
C. D. (P=0.05)	4.56	7.05	-	2.07	4.93	-	6.31	5.22	-	12.07	11.31	-

Branches/plant

An examination of data on number of branches/plant, it was observed that the year 2018-19 was also more favourable for branches/plant with overall performance 13.38 as compared to 2017-18 (5.51). The number of branches/plant is highly sensitive to availability of soil moisture during the early stages of plant growth. If available soil moisture is low during the early stages of plant growth, particularly at the time of primordial formation for branch development, it drastically reduces the number of branches/plant. During 2017-18, the drastic reduction was observed in number of branches/plant, due to non-availability of irrigation during the early stages of plant growth During 2017-18, the number of branches/plant were recorded maximum for HCI-6 and HCI-7 with 7.20 branches/plant followed by HCI-5 (7.00), HCI-8 (6.40), HCI-13 (6.40) and HCI-14 (6.40). During 2018-19, HCI-1 recorded maximum number of branches/plant with 24.03 branch/plant followed by HCI-19 (21.33), HCI-3 (21.00), HCI-20 (19.67) and HCI-7 (19.33). The evaluation of genotypes over the years exhibited that HCI-1 (14.70) had the maximum number of branches/plant and followed by HCI -7 (13.27), HCI -3 (12.60), HCI -19 (12.47) and HCI -20 (12.34).

Seed yield/ plot (g)

An examination of data on seed yield/plot (g), it was observed that the year 2018-19 was more favourable for seed yield/plot (38.60g) as compared to 2017-18 (33.99). During 2017-18, HCI-3 was at top yielder with 57.69g seed yield/plot followed by HCI-16 (56.07 g/plot), HCI-4 (51.17 g/plot), HCI-19 (48.93 g/plot) and HCI-20 (147.89 g/plot). During 2018-19, HCI-16 with 57.33g seed yield/plot was the top performing genotype followed by HCI-3 (56.33 g/plot), HCI-1 (52.69 g/plot), HCI-20 (42.33 g/plot), HCI-5 (41.67 g/plot) and HCI-14 (41.00 g/plot). The evaluation of genotypes over the years exhibited that HCI-3 (57.01 g/plot), had the maximum seed yield/ plot and followed by HCI-16 (56.70 g/plot), HCI -4 (45.60 g/plot), HCI -20 (45.11 g/plot) and HCI-1 (44.81g/plot). The different genotypes varied in seed yield performance during both the years due the differences in genotypes, environmental conditions and genotypes x environmental interaction.

Seed yield (kg/ha)

The results on seed yield (kg/ha) presented in table 1, revealed that the year 2018-19 was also most favourable for seed yield (kg/ha) production and produced maximum average seed yield 214.44 kg/ha followed by 2017-18 (188.81 kg/ha). During 2017-18, HCI-3 produced maximum seed yield (320.48 kg/ha) and followed by HCI-16 (311.49 kg/ha), HCI-4 (284.29 kg/ha), HCI-19 (271.81 kg/ha) and HCI-20 (266.07 kg/ha). During 2018-19, HCI-16 with 318.49 seed yield (kg/ha) was the top performing genotype followed by HCI-3 (312.94 kg/ha), HCI-1 (292.71 kg/ha), HCI-20 (235.16 kg/ha), HCI-5 (231.49 kg/ha) and HCI-14 (227.77 kg/ha). The evaluation of genotypes over the years exhibited that HCI -3 (316.71 kg/ha) had the maximum seed yield followed by HCI-16 (314.99 kg/ha), HCI -4 (253.34 kg/ha), HCI -20 (250.62 kg/ha) and HCI-1 (248.94 kg/ha). Under moisture stress, the leaf gas exchange of plant is reduced and this leads to lower biomass accumulation which ultimately results in reduction in seed yield (Arya *et al*., 2014). The unfavorable environment at early stages of growth and development had more harmful effect and it reduces number of branches and also gives stimulus to the plants for early flowering resulting in reduction in plants normal size thus reduction in biological yield and ultimately leads to reduction in seed yield (Arya *et al*., 2010). It may be concluded from present investigation that HCI -3 (316.71 kg/ha), HCI-16 (314.99 kg/ha), HCI -4 (253.34 kg/ha), HCI -20 (250.62 kg/ha) and HCI-1 (248.94 kg/ha) are promising genotypes and needs further testing over time and space before to recommend for commercial cultivation.

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