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EVALUATION OF FABA BEAN ELITE GENOTYPES FOR SEED YIELD AND QUALITY PARAMETERS UNDER HARYANA CONDITIONS

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SUMMARY

The field experiment on faba bean (*Vicia faba* L.) was conducted in RBD by using 13 elite genotypes including two checks during *rabi* 2019-20 and 2020-21 at Research Farm of MAP Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar. In the present study, wide genetic variability was observed for plant height (cm), days to flowering, days to maturity, and seed yield (kg/ha). During 2019-20, out of 13 genotypes, the genotype HB 15-21 recorded the highest seed yield (4236.11 kg/ha) followed by HB 15-41 (3941.24 kg/ha), HFB 1 (C) (3881.48 kg/ha), HB 15-04 (3703.70 kg/ha), Vikrant (C) (3653.70 kg/ha), HB 13-38 (3587.50 kg/ha). During 2020-21, the maximum seed yield (kg/ha) was observed in HB 13-38 (3291.75 kg/ha) followed by HB 15-17 (3183.25 kg/ha), HB 15-07 (3178.00 kg/ha), HB 15-14 (3139.00 kg/ha). However, on average basis, protein content was found maximum in HB 15-51 (27.55%) followed by NDFB 17-01 (27.26%), HFB 1 (C) (27.26%), HB 15-17 (27.13%), HB 13-38 27.11%), Vikrant (C) (27.07%). These elite genotypes have good potential for commercial cultivation, but to be tested over time and space before recommendation for commercial cultivation.

Key words : Seed yield, quality parameters, disease resistance, faba bean (*Vicia faba* L.), elite genotypes

India has approximately 20 percent of world's livestock and 16.8 percent human population with only 2.3 percent of the geographical area of the world. India is mainly rearing cattle (16.0%) and buffalo (5.5%) for milk production. The Indian livestock sector contributes about 32 percent of the total agricultural output, which is 22 percent of the total GDP in India. The shortage in feed and fodder for animals has been well-known as one of the major limiting factor in achieving the desired level of livestock production (Kumar *et al*., 2012). In India, Faba bean (*Vicia faba* L.) is considered as one of the potential legume plant (Bishnoi *et al*., 2012). It is mainly *rabi* season crop and very important for crop rotation, as it fixes atmospheric nitrogen in the soil with the help of *Rhizobium* bacteria and help to economize the following crops (Arya, 2018; Raiger *et al*., 2021). It is grown in Bihar, Uttar Pradesh, Himanchal Pradesh, Punjab, Madhya Pradesh, Karnatka, Chhattisgarh, Odisha, Jharkhand and North Eastern states of India. This crop is widely grown for forage, vegetable, pulse, green manure and as a cover crop (Arya *et al*., 2020).

It may act as a source of protein for human beings and animals to ensure food and nutritional security at global level due its high nutritive value due to presence of high lysine, protein, vitamins, minerals and carbohydrates in its seeds (Bishnoi *et al*., 2015). Lapierre *et al*. (2003) suggested the substitution of soybean meal in cow diets by a mixture of 1/3 of rapeseed meal and 2/3 of faba bean (with 3.7 kg/cow/day). It was observed that the utilization of 30% of ground faba bean in the feed for dairy cows does not alter the feed consumption, the milk production (higher than 30 kg/cow/day) or the milk composition (crude protein or lipid). It represents an average consumption of faba bean of 3.5 kg per day and per animal. It is rich in L-dopa, a substance used medically in the treatment of Parkinson's disease. L-dopa is also a neurotic agent, which might help in controlling hypertension (Kumar *et al*., 2019).

As other legume raw seeds, the nitrogen fraction of faba bean is highly soluble and easily degradable in the rumen of animals. Nitrogen degradability decreases when the grinding screen changes from 0.8 to 3.0 mm. A finer grinding results in a higher nitrogen degradability and consequently in a lower value of digestible protein in the intestine (PDI value). The energy values of faba bean for ruminant (UFL and UFV) are high, comparable to cereal energy values (Sauvant *et al*., 2004) and explained by the

high starch content of the seeds. Like other legumes, the beneficial effect of pelleting being explained by a better starch and protein digestibility Pelleting has a very positive and significant effect on the AMEn value of faba bean fed to young chicks (Lacassagne *et al*., 1988). The increase in the AMEn value that can be attributed to pelleting is about 1.23 MJ/kg DM i.e. 12% of the AMEn value of unpelleted faba bean (Crepon *et al*., 2010). The lowering of VC and tannin contents in faba bean seeds has a significant and additive positive impact on AMEn values in broiler chickens (Vilarino *et al*., 2009).

The faba bean crop has high potential of seed production, and its seed has balanced and high nutritional quality and also has ability to grow over a broad range of climatic and soil conditions, therefore, faba bean is an appropriate crop for sustainable agriculture and it has gained greater global attention in recent years. Faba bean is a protein-rich legume seed well adapted to most climatic areas of Europe and widely used for feed and food. Therefore, keeping the above facts in view, the utilization of elite genotypes in hybridization to develop new varieties through pedigree method of selection was carried out.

MATERIALS AND METHODS

The identified elite genotypes viz., HB 15-04, HB 15-14, HB 15-21, HB 15-34, HB 15-41, HB 15-51, HB 15-55, HB 13-11, HB 13-38, HB 15-17, HB 15-07, NDFB 17-01with check variety, HFB-1 and Vikrant were evaluated during 2019-20 and 2020-21, respectively, to identify the best performing high yielding varieties of faba bean in Research Area of MAP Section, CCS HAU, Hisar. The field experiments were sown in RBD with three replications. The plot size was kept 3.0 m x 2.4 m with spacing 30 cm x 10 cm. Each genotype was planted in eight rows of three meter length spacing 30 cm apart to each other. All the recommended package of practices was carried out to raise a good crop. The observations were recorded on five competitive plants for days to 50% flowering, days to maturity, plant height (cm), seed yield (q/ha) and 100 seed weight (g). The seeds of elite genotypes were tested for quality parameters i.e. protein content (%), vicine-convicine (%) and phenol (%) in quality testing laboratory at MAP Section, CCS HAU, Hisar centre as per standard procedures. Statistical analysis was carried out as per standard procedure (Sheoran *et al*., 1998).

RESULTS AND DISCUSSION

Faba bean is a protein-rich legume seed, well adapted to most climatic areas of Europe and Asia, and widely used for feed and food. Even if the seed is generally recognized to be of good nutritional value, existing genetic variability offers possibilities for improvement through breeding (Crepon *et al*., 2010).In the present investigation, 11 of elite of faba bean were screened for yield and its contributing traits as well as resistance to biotic and abiotic stresses.Likewise, faba bean genotypes were also evaluated for seed yield and other related by Arya *et al*. (2019).

Yield and other traits

The data presented in table 1 revealed that, during 2019-20, the maximum seed yield (kg/ha) was found in HB 15-21 (4236.11kg/ha) followed by HB 15-41 (3941.24kg/ha), HFB 1 (C) (3881.48 kg/ha), HB 15-04 (3703.70 kg/ha), Vikrant (C) (3653.70 kg/ha), HB 13-38 (3587.50 kg/ha), HB 15-34 (3425.92 kg/ha), HB 15-14 (3307.87 kg/ha), HB 15-07 (3320.83 kg/ha), HB 13-11 (3293.40 kg/ha), NDFB 17-01 (3284.73 kg/ha), HB 15-55 (3240.74 kg/ha), HB 15-51 (2731.48 kg/ha) and HB 15-17 (2618.06 kg/ha). During 2020-21, the maximum seedyield (kg/ha) was observed in HB 13-38 (3291.75 kg/ha) followed by HB 15-17 (3183.25 kg/ha), HB 15-07 (3178.00 kg/ha), HB 15-14 (3139.00 kg/ha), HB 13-11 (2965.25 kg/ha), HB 15-55 (2949.50 kg/ha), NDFB 17-01 (2910.00 kg/ha), HB 15-04 (2909.25 kg/ha), HB 15-51 (2894.75 kg/ha), Vikrant (C) (2874.00 kg/ha), HB 15-34 (2784.00 kg/ha), HB 15-41 (2765.75 kg/ha), HFB 1 (C) (2747.75 kg/ha) and HB 15-21 (2562.25 kg/ha). Likewise, the newly developed genotypes of faba bean were also evaluated in station trial by Arya (2018). Moreover, grain yield is a polygenetic trait which is highly affected by prevailing environmental conditions such as temperature, soil moisture and fertility during the plant growth and mainly during pod filling. Above findings were supported by Arya *et al.,* 2014.

In year 2019-20, maximum plant height (cm) was achieved by HB 15-17 (103.50 cm) followed by NDFB 17-01 (99.20 cm), HB 15-41 (95.66 cm), HFB 1 (C) (92.95 cm), HB 15-34 (91.70 cm), HB 15-51 (91.28 cm), HB 15-04 (90.57 cm), HB 13-11 (90.50 cm), HB 15-14 (89.64 cm), Vikrant (C) (89.19 cm),

HB 15-21 (87.69 cm), HB 15-55 (88.59 cm), HB 15-07 (86.05 cm) and HB 13-38 (80.40 cm). In year 2020-21, maximum plant height (cm) was achieved by HB 13-38 (95.25 cm) followed by HB 13-11(94.00 cm), HB 15-17 (92.75 cm), HB 15-14 (92.50 cm), HB 15-07 (92.00 cm), Vikrant (C) (90.50 cm), HFB 1 (C) (89.25 cm), NDFB 17-01 (87.75 cm), HB 15-41 (87.75 cm), HB 15-34 (86.75 cm), HB 15-21 (86.50 cm), HB 15-55 (85.25 cm), HB 15-51(82.50 cm) and HB 15-04 (82.25 cm).

During 2019-20, on the basis of days to 50% flowering, the genotype NDFB 17-01 (78.25days) was earliest in flowering and followed by Vikrant (C) (78.75 days), HB 15-07 (79.25 days), HB 15-34 (79.75 days), HB 13-38 (79.75 days), HB 15-17 (80.00 days), HB 15-04 (80.00 days), HB 15-14 (80.25 days), HB 15-21 (80.25 days), HFB 1 (C) (80.50 days), HB 15-41 (81.00 days), HB 15-55 (81.75 days), HB 13-11 (84.00 days) and HB 15-51 (84.50 days). Likewise, during 2020-21, HB 15-07 (65.75 days) was found early in flowering followed by HB 15-34 (66.00 days), HB 15-04 (66.00 days), NDFB 17-01 (66.00 days), HB 15-55 (66.00 days), HFB 1 (C) (66.00 days), HB 15-17 (66.50 days), Vikrant (C) (66.75 days), HB 13-11 (67.25 days), HB 15-14 (67.50 days), HB 13-38 (68.50 days), HB 15-51 (69.00 days), HB 15-21 (69.00 days) and HB 15-41 (69.25 days).

During 2019-20, HB 15-21 (145.00days) was found early maturing and followed by NDFB 17-01 (145.75 days), HB 15-04 (146.00 days), HB 15-34 (146.50 days), HB 15-55(146.75 days), HFB 1 (C) (146.75 days), Vikrant (C) (147.75 days), HB 15-41(147.75 days), HB 15-51 (148.00 days), HB 15-07 (148.25 days), HB 15-14 (149.00 days), HB 15-17 (149.50 days), HB 13-38(149.75 days) and HB 13-11 (150.25 days). During 2020-21, the earliest maturing genotype was HB 15-04 (134.50 days) followed by HB 15-14 (139.80 days), HB 15-21 (139.50 days), HB 15-34 (135.00 days), HB 15-41 (139.30 days), HB 15-51 (139.80 days), HB 15-55 (135.30 days), HB 13-11(135.50 days), HB 13-38 (136.30 days), HB 15-17 (135.50 days), HB 15-07 (135.50 days), NDFB 17-01 (135.50 days), Vikrant (C) (135.30 days) and HFB 1 (C) (134.50 days).

Quality Parameters

The faba bean is one of good source of protein and it is directly revealed from table 2. During 2019-20, protein content was found maximum in HB 15-51 (27.70%) followed by NDFB 17-01 (27.03%), HB 15-41 (26.87%), HB 15-17 (26.86%), Vikrant (C) (26.36%), HB 13-38 (26.06%), HFB 1 (C) (25.74%), HB 15-34 (25.63%), HB 15-21 (25.41%), HB 15-04 (24.97%), HB 15-55 (24.82%), HB 15-07 (24.66%), HB 13-11 (23.67%) and HB 15-14 (23.66%). However, during 2020-21, protein content was found maximum inHFB 1 (C) (28.77%) followed by HB 13-38

TABLE 1
Performance of elite genotypes of Faba bean for seed yield and other traitsduring 2019-20 and 2020-21 at Hisar

Entry No.	Plant height (cm)			Days to 50% flowering			Days to maturity			Seed yield (kg/ha)		
	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean
HB 15-04	90.57	82.25	86.41	80.00	66.00	73.00	146.00	134.50	140.25	3703.70	2909.25	3306.48
HB 15-14	89.64	92.50	91.07	80.25	67.50	73.88	149.00	139.80	144.40	3307.87	3139.00	3223.44
HB 15-21	87.69	86.50	87.10	80.25	69.00	74.63	145.00	139.50	142.25	4236.11	2562.25	3399.18
HB 15-34	91.70	86.75	89.23	79.75	66.00	72.88	146.50	135.00	140.75	3425.92	2784.00	3104.96
HB 15-41	95.66	87.75	91.71	81.00	69.25	75.13	147.75	139.30	143.53	3941.24	2765.75	3353.50
HB 15-51	91.28	82.50	86.89	84.50	69.00	76.75	148.00	139.80	143.90	2731.48	2894.75	2813.12
HB 15-55	88.59	85.25	86.92	81.75	66.00	73.88	146.75	135.30	141.03	3240.74	2949.50	3095.12
HB 13-11	90.50	94.00	92.25	84.00	67.25	75.63	150.25	135.50	142.88	3293.40	2965.25	3129.33
HB 13-38	80.40	95.25	87.83	79.75	68.50	74.13	149.75	136.30	143.03	3587.50	3291.75	3439.63
HB 15-17	103.50	92.75	98.13	80.00	66.50	73.25	149.50	135.50	142.50	2618.06	3183.25	2900.66
HB 15-07	86.05	92.00	89.03	79.25	65.75	72.50	148.25	135.50	141.88	3320.83	3178.00	3249.42
NDFB 17-01	99.20	87.75	93.48	78.25	66.00	72.13	145.75	135.50	140.63	3284.73	2910.00	3097.37
Vikrant (C)	89.19	90.50	89.85	78.75	66.75	72.75	147.75	135.30	141.53	3653.70	2874.00	3263.85
HFB 1 (C)	92.95	89.25	91.10	80.50	66.00	73.25	146.75	134.50	140.63	3881.48	2747.75	3314.62
Mean	91.21	88.93	90.07	80.57	67.11	73.84	147.64	136.52	142.08	3444.77	2939.61	3192.19
SE(m)	2.07	3.06		0.40	0.47		0.86	0.59		222.26	88.74	
CD (P=0.05)	5.87	N/A		1.13	1.36		2.44	1.71		629.62	254.79	
CV (%)	4.62	6.87		0.98	1.41		1.16	0.87		14.68	6.04	

(28.16%), Vikrant (C) (27.77%), HB 15-07 (27.71%), NDFB 17-01 (27.48%), HB 13-11 (27.44%), HB 15-51 (27.39%), HB 15-17 (27.39%), HB 15-55 (27.37%), HB 15-04 (27.10%), HB 15-21 (26.79%), HB 15-34 (26.44%), HB 15-14 (26.03%) and HB 15-41 (25.38%). However, on average basis, protein content was found maximum in HB 15-51 (27.55%) followed by NDFB 17-01 (27.26%), HFB 1 (C) (27.26%), HB 15-17 (27.13%), HB 13-38 27.11%), Vikrant (C) (27.07%), HB 15-07 (26.19%), HB 15-41 (26.13%), HB 15-55 (26.10%), HB 15-21 (26.10%), HB 15-04 (26.04%), HB 15-34 (26.04%), HB 13-11 (25.56%) and HB 15-14 (24.85%). The faba bean seed is generally recognized to be of good nutritional value, existing genetic variability for seed composition offers possibilities for improvement of this trait by breeding (Crepon *et al*., 2010).

During 2019-20, 100 seed weight was found maximum in HFB 1 (C) (34.46g) followed by HB 15-07 (34.22g), HB 15-51 (32.86g), Vikrant (C) (32.27g), HB 15-21 (32.02g), HB 15-04 (31.91g), HB 13-38 (31.73g), HB 15-14 (31.68g), HB 15-17 (31.56g), HB 13-11 (31.34g), HB 15-34 (30.71g), NDFB 17-01 (30.46g), HB 15-41 (30.12g), HB 15-55 (29.98g). However, during 2020-21, 100 seed weight was found maximum in HB 15-51 (30.98g) followed by HB 13-38 (30.58g), NDFB 17-01(30.12g), HB 15-04 (30.08g), HB 15-14 (29.97g), HB 15-21 (29.67g), HB 13-11 (29.55g), Vikrant (C) (29.30g), HB 15-34 (29.22g), HB 15-17 (29.16g), HB 15-41 (28.62g), HB 15-07 (28.36g) and HFB 1 (C) (28.07g).

During 2019-20, total phenol (%) was found maximum in HB 15-04 (0.14%) followed by HB 13-38 (0.14%), HFB 1 (C) (0.14%), HB 15-21 (0.13%), HB 15-17 (0.13%), HB 15-07 (0.13%), Vikrant (C) (0.13%), NDFB 17-01 (0.13%), HB 15-34 (0.12%), HB 15-14 (0.12%), HB 15-55 (0.11%), HB 15-51 (0.11%), HB 13-11 (0.10%) and HB 15-41 (0.10%). However, during 2020-21, total phenol (%) was found maximum in HB 15-04 (0.14%) and HB 13-38 (0.14%) followed by HFB 1 (C) (0.14%), HB 15-17 (0.13%), HB 15-07 (0.13%), NDFB 17-01 (0.13%), Vikrant (C) (0.13%), HB 15-21 (0.13%), HB 15-34 (0.12%), HB 15-14 (0.12%), HB 15-51 (0.11%), HB 15-55 (0.11%), HB 15-41 (0.10%) and HB 13-11 (0.10%).

Vicine-convicine (%) during 2019-20, was found lowest in HB 15-14 (0.63%) followed by HFB 1 (C) (0.69%), HB 15-51 (0.76%), HB 15-41 (0.77%), HB 15-34 (0.79), HB 15-21 (0.80%), HB 15-07 (0.81%), HB 15-04 (0.83%), HB 15-55 (0.87%), Vikrant (C) (0.88%), HB 15-17 (0.90%), NDFB 17-01 (0.91%), HB 13-38 (0.96%) and HB 13-11 (0.97%). During 2020-21, Vicine-convicine(%) was found lowest in HB 15-14 (0.74%) and HB 15-34 (0.74%) followed by HFB 1 (C) (0.76%), Vikrant (C) (0.80%), HB 15-07 (0.80%), HB 15-17 (0.80%), HB 15-04 (0.81%), HB 15-51 (0.83%), HB 13-11 (0.85%), HB 13-38 (0.85%), HB 15-55 (0.86%), HB 15-21

TABLE 2
Performance of elite genotypes of Faba bean for quality parametersduring 2019-20 and 2020-21 at Hisar

Entry No.	100 seed weight (g)			Protein (%)			Total Phenol (%)			V-C (%)		
	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean
HB 15-04	31.91	30.08	31.00	24.97	27.10	26.04	0.16	0.14	0.15	0.83	0.81	0.82
HB 15-14	31.68	29.97	30.83	23.66	26.03	24.85	0.16	0.12	0.14	0.63	0.74	0.69
HB 15-21	32.02	29.67	30.85	25.41	26.79	26.10	0.15	0.13	0.14	0.80	0.87	0.84
HB 15-34	30.71	29.22	29.97	25.63	26.44	26.04	0.20	0.12	0.16	0.79	0.74	0.77
HB 15-41	30.12	28.62	29.37	26.87	25.38	26.13	0.20	0.10	0.15	0.77	0.90	0.84
HB 15-51	32.86	30.98	31.92	27.70	27.39	27.55	0.14	0.11	0.13	0.76	0.83	0.80
HB 15-55	29.98	30.09	30.04	24.82	27.37	26.10	0.19	0.11	0.15	0.87	0.86	0.87
HB 13-11	31.34	29.55	30.45	23.67	27.44	25.56	0.17	0.10	0.14	0.97	0.85	0.91
HB 13-38	31.73	30.58	31.16	26.06	28.16	27.11	0.19	0.14	0.17	0.96	0.85	0.91
HB 15-17	31.56	29.16	30.36	26.86	27.39	27.13	0.19	0.13	0.16	0.90	0.80	0.85
HB 15-07	34.22	28.36	31.29	24.66	27.71	26.19	0.19	0.13	0.16	0.81	0.80	0.81
NDFB 17-01	30.46	30.12	30.29	27.03	27.48	27.26	0.19	0.13	0.16	0.91	0.89	0.90
Vikrant (C)	32.27	29.30	30.79	26.36	27.77	27.07	0.17	0.13	0.15	0.88	0.80	0.84
HFB 1 (C)	34.46	28.07	31.27	25.74	28.77	27.26	0.15	0.14	0.15	0.69	0.76	0.73
Mean	31.81	29.56	30.68	25.67	27.23	26.45	0.18	0.12	0.15	0.83	0.82	0.82
SE(m)	0.18	0.68		0.46	0.25		0.01	0.00		0.04	0.02	
CD (P=0.05)	0.5	NS		1.32	0.74		0.03	0.01		0.13	0.05	
CV (%)	0.61	4.58		3.179	1.61		7.93	4.71		8.58	3.43	

TABLE 3
Screening of fababean entries against Alternaria leaf blight and root rot disease

S. No.	Genotype	Alternaria blight (% severity)	Disease reaction	Root rot incidence (%)	Disease reaction
1.	HB 15-04	26.70	MS	25.00	S
2.	HB 15-14	17.80	MR	23.30	S
3.	HB 15-21	9.50	R	22.50	S
4.	HB 15-34	5.00	R	3.30	R
5.	HB 15-41	8.30	R	24.10	S
6.	HB 15-51	28.60	MS	5.00	R
7.	HB 15-55	42.50	S	15.00	MR
8.	HB 13-11	7.30	R	13.30	MR
9.	HB 13-38	8.90	R	21.60	S
10.	HB 15-17	12.80	MR	12.50	MR
11.	HB 15-07	36.70	S	24.10	S
12.	NDFB 17-01	18.90	MR	14.10	MR
13.	Vikrant (C)	21.10	MS	11.60	MR
14.	HFB 1 (C)	6.70	R	4.50	R

(0.87%), NDFB 17-01 (0.89%) and HB 15-41 (0.90%).Although, the quality parameters are also determined by genetic constitution of a genotype but these are also influenced by environmental factors and management practices (Arya *et al*., 2014; Kumar *et al*., 2019). The availability of high protein content and low content of vicine-convicine reflects the suitability of some genotypes for utilization as feed for animals at commercial scale.

Pathological studies

Screening of faba bean entries against Alternaria leaf blight and root rot diseases exhibited that, only one entry, HB 15-34 and check, HFB-1 showed multiple resistance against both the diseases (table 3). The resistance against the biotic factor is most desirable trait for all kind of varieties for commercial cultivation. In addition to this, HB 15-11 was found resistant to Alternaria leaf blight and moderately resistant to and root rot disease whereas HB 15-17 and NDFB 17-01 were found moderately resistant to Alternaria leaf blight and root rot disease. Moreover, HB 15-21, HB 15-41were found resistant to Alternaria leaf blight. Opposite to this, HB 15-51 found resistant and HB 15-55 found moderately resistant to root rot disease.

The utilization of faba bean seeds in animal and human nutrition have been reviewed, by Kopke and Nemecek (2010). They advocated that the faba bean plant has the potential of several positive ecological services in production and animal husbandry.

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