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HJH 1513: SINGLE CUT FORAGE SORGHUM HYBRID FOR HARYANA

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SUMMARY

HJH 1513, a single-cut forage sorghum hybrid with high biomass yield and quality was developed by cytoplasmic male sterility in Forage Section, Department of Genetics & Plant Breeding, CCS Haryana Agricultural University, Hisar. It is released & notified for cultivation in *kharif* season for all sorghum growing areas of Haryana. HJH 1513 produced 716.5 q/ha green fodder yield (mean of three years) which is 42.25 % increase over the check CSH 13 (503.66 q/ha) on the basis of three-year data in Haryana. Dry fodder yield of HJH 1513 was 160.5 q/ha which is 47.9 % increase over the check CSH 13 (126.7 q/ha) on the basis of three-year data in Haryana. HJH 1513 has shown 12.33, 7.55 and 10.95 per cent superiority for green fodder yield over CSV 21F, HJ 541 and HJ 513, respectively at F_3 fertility level *i.e*. 125% RDF. It has high total soluble solids (TSS) *i.e* 6.87% which is on par with checks CSH13 and HJ 541. It possesses 82.57 µg/g hydrocyanic acid (HCN) content which is less than permissible limit of 200 µg/g. Crude protein content was 8.59 percent and *In-vitro* dry matter digestibility (IVDMD) was 52.96 percent which is higher than the best check CSH 13. It is resistant against major foliar diseases like zonate leaf spot, sooty stripe and grey leaf spot. This hybrid is moderately tolerant to shoot fly and stem borer.

Key Words: Forage, hybrid, fodder, quality, disease resistance

Forage sorghum is the 5th most important cereal grown in arid and semi arid tropics of India for silage, hay and grazing. It is more suitable for tropical regions having limited moisture. It has high crude protein concentration, *invitro* dry matter digestibility and palatability making it a nutritive forage with good regeneration potential as compared to other fodder crops of *summer* and *kharif* seasons especially of North India (Ghosh *et al.,* 2016). It belongs to family Poaceae and its genome size is 730 Mbp (approx.) (Paterson *et al*., 2009).

The major constraint for low production and productivity of fodder crops in the country are decease in area under fodder crops, non-availability of quality seed, unawareness of farmers about improved cultivars etc. Continuous supply of green and dry fodder is primary requirement for the success of any dairy industry. Introduction of high fodder yielding varieties/ hybrids ranks first (Bilal et al. 2001) and availability of seed comes next solution for the above situation. The government agency and NGOs could play a crucial role in this direction. Absence of improved genotype, weed control, plant protection, fertilizer and irrigation resulted in 39, 33, 31, 30 and 22 per cent losses in the productivity of fodder sorghum as compared to full package of practices (Satpal *et al.,* 2021).

According to ICAR- IGFRI, Jhansi 2022 report there is deficit of 11.24%, 23.4 % and 28.9% green fodder, dry fodder and concentrates, respectively in the country. Sorghum is next to maize for fodder due to its quality but high moisture requirement stands the fodder maize next to forage sorghum but fodder quality of BMR (Brown midrib) types is at par with maize (Saballos *et al*., 2008). Sorghum has the ability to maintain high biomass under stress environment (Tonapi *et al*., 2020). Forage sorghum also have high digestibility in their fodder as compared to grain sorghum.

Forage Section, Deptt. Of Genetics and Plant Breeding, CCS Haryana Agricultural University is continuously doing efforts since 1970 to develop improved varieties/hybrids of important forage crops for cultivation in all sorghum growing areas of the country. For quantum jump in yielding ability of fodder

crops heterosis breeding could be exploited (Chakraborthy et al., 2020). So, keeping above points in consideration from continuous efforts of researchers improved single-cut forage sorghum hybrid HJH 1513, was released and notified vide **S.O.E. No. 1056(E) dated 06.03.2023** Gazette Notification Ministry of Agriculture and Farmers Welfare under Department of Agriculture, Cooperation and Farmers Welfare, GOI, New Delhi, for cultivation in all sorghum growing areas of Haryana state under timely sown, normal fertility and irrigated conditions during *kharif* season. It is tan, sweet, tall, having high green and dry fodder yield with good quality, moderately tolerant to stem borer and shoot fly and resistant against major foliar diseases as given in Fig. 1.

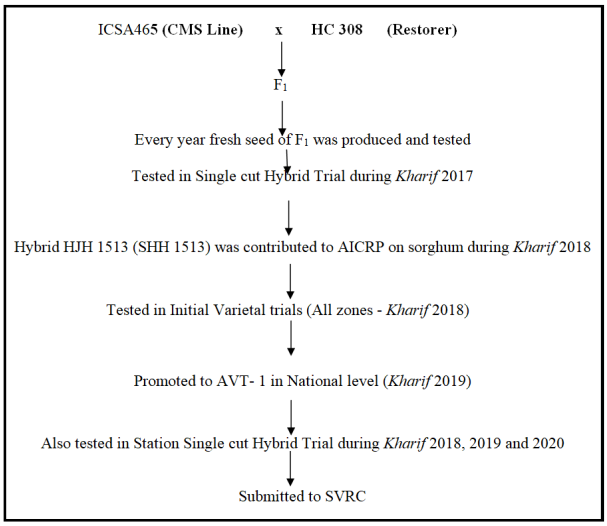

Fig. 1. Pedigree of forage sorghum variety HJH 1513.

Fodder yield performance of HJH 1513

Green fodder yield of this hybrid is 716.5 q/ha (mean of three years) which is 42.25 % more than the check CSH 13 (503.66 q/ha) in station trials (Table 1). Similarly, dry fodder yield was 181.4 q/ha (mean of three years) which is 47.9 % more than the check CSH 13 (126.7 q/ha) in station trials (Table 2). It is tall, flowers at 80 days after sowing and has leaf length 83.93cm (Table 5). Field view of HJH 1513 is shown in Fig. 2. For getting maximum green fodder yield and better quality like high crude protein percent and *in vitro* dry matter digestibility crop should be harvested at the time of 50 percent flowering (approx. 80 days after sowing).

Quality attributes of HJH 1513

As far as fodder quality of HJH 1513 is concerned it has high total soluble solids (TSS%) *i.e* 6.87%. HCN content of this hybrid is 82.57 µg/g which is far less than permissible limit of 200 µg/g (on fresh wt. basis). Crude protein content is 8.59 percent and *In-vitro* dry matter digestibility (IVDMD) is 52.95 percent which is comparable to both checks (Table 6).

Performance against major foliar diseases and insect pests

This hybrid is moderately tolerant to shoot fly and stem borer. This hybrid HJH 1513 recorded

TABLE 1
Comparative performance of HJH 1513 for green fodder yield (q/ha) in Haryana from *kharif* 2018 to *kharif* 2020

Year	Location	HJH 1513 (SHH 1513)	CSH 13 (Hybrid Check)	CD (p=0.05)	CV (%)
Kharif 2018	Hisar	1020.0	683.3	188.2	14.09
Kharif 2019	Hisar	567.3	478.4	-	17.3
Kharif 2020	Hisar	562.3	349.3	151.2	19.3
Overall Mean		716.5	503.66	-	-
% increase over checks		-	42.25	-	-

TABLE 2
Comparative performance of HJH 1513 for dry fodder yield (q/ha) in Haryana from *kharif* 2018 to *kharif* 2020

Year	Location	HJH 1513 (SHH 1513)	CSH 13 (Hybrid Check)	CD (p=0.05)	CV (%)
Kharif 2018	Hisar	270.3	173.3	53.2	15.42
Kharif 2019	Hisar	137.7	119.2	-	16.8
Kharif 2020	Hisar	136.3	87.7	36.1	17.9
Overall Mean		181.4	126.7	-	-
% increase over checks		-	47.9	-	-

Fig. 2. Field view of HJH 1513 along with parents ICSA465 & HC 308.

TABLE 3
Adaptability to agronomic variables for green fodder yield (q/ha) during *kharif* 2019 under Haryana Conditions

Name of proposed hybrid: HJH 1513 (SHH 1513)
Adaptability Zone: Haryana state

Nature of experiment	Item	Proposed hybrid HJH 1513 (SHH 1513)	National Check 1 CSV 21F	State Check 1 HJ 541	State Check 2 HJ 513
Fertilizer experiment	Green fodder yield (q/ha) at 75% of recommended dose of fertilizer (75% RDF *i.e.* F_1)	510.0	445.0	453.6	432.1
	Green fodder yield (q/ha) at recommended dose of fertilizer (100% RDF *i.e.* F_2)	527.1	469.8	465.5	457.6
	Green fodder yield (q/ha) at 125% of recommended dose of fertilizer (125% RDF *i.e.* F_3)	557.4	496.2	518.3	502.4
	Percentage gain or loss under other doses i) F_1	-	14.61	12.43	18.03
	ii) F_2	-	12.20	13.23	15.19
	iii) F_3	-	12.33	7.54	10.95

TABLE 4
Net return and B:C ratio of HJH 1513 (SHH 1513) at different fertility levels

Treatment	Net Return (Rs./ha) 75% RDF	B:C ratio	Net Return (Rs./ha) 100% RDF	B:C ratio	Net Return (Rs./ha) 125% RDF	B:C ratio
HJH 1513 (SHH 1513)	28636	1.81	30394	1.86	33784	1.94
CSV 21F	20511	1.58	23222	1.66	26135	1.73
HJ 541	21583	1.62	22686	1.64	28903	1.81
HJ 513	18904	1.54	21704	1.61	26909	1.75

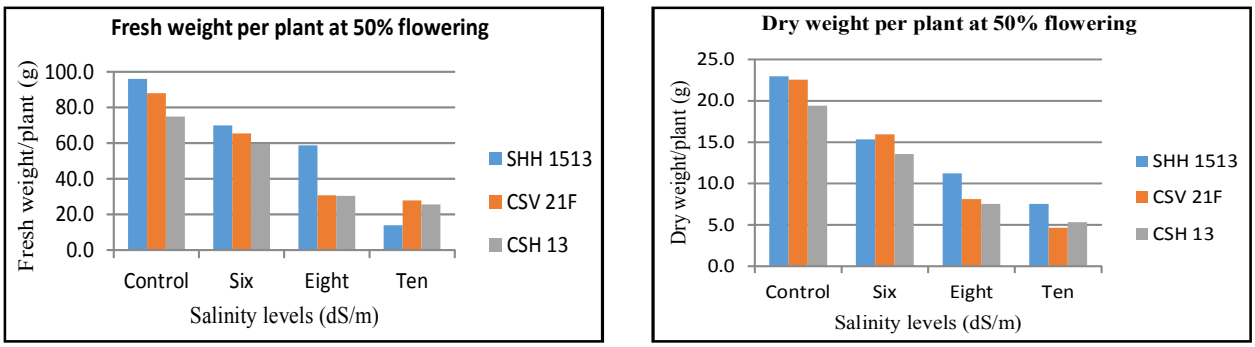

Fig. 3. Performance of HJH 1513 at different salinity levels.

TABLE 5
Mean performance of HJH 1513 (SHH 1513) for morphological traits in Haryana from *kharif* 2018 to *kharif* 2020

Morphological parameters	HJH 1513 (SHH 1513)	CSH 13	HJ 541
Days to 50% flowering *Kharif* 2020	80.00	81.30	84.50
Plant Height (cm) *Kharif* 2018	266.07	201.97	259.03
No. of leaves/plant *Kharif* 2018	20.93	20.93	19.73
Leaf Length (cm) *Kharif* 2018	83.93	76.60	79.63
Leaf Breadth (cm) 2018 Leaf/Stem ratio	7.83	8.10	7.67
Kharif 2018	0.26	0.29	0.27
Stem Girth (mm)	16.37	17.40	16.63

TABLE 6
Mean performance of HJH 1513 (SHH 1513)) for quality parameters in Haryana from *kharif* 2018 to *kharif* 2020

Characteristics	SPH 1917 (SHH 1513)	CSH 13	Local Check
HCN (µg/g)	82.57	61.71	46.50
TSS %	6.87	7.51	6.95
Crude protein %	8.59	8.53	8.49
IVDMD%	52.95	52.78	51.95

16.3% shoot fly dead hearts which is marginally less than checks HJ 541 and HJ 513 with 20.8 % and 19.7 % shootfly dead hearts, respectively. The stem borer dead hearts were recorded 18.1%, which is marginally less than checks HJ 541 and HJ 513 with 16.5% and

TABLE 7
Reaction of HJH 1513 (SHH 1513) against major insect pests in Haryana under natural conditions

Traits	Year	HJH 1513 (SHH 1513)	HJ 541	HJ 513
Stem borer deadhearts (%)	*Kharif* 2019	17.8	15.2	18.4
	Kharif 2020	18.33	17.73	16.27
Mean		18.1*	16.5	17.3
Shoot fly dead hearts (%)	*Kharif* 2019	12.0	16.0	19.3
	Kharif 2020	20.6	25.6	20.17
Mean		16.3*	20.8	19.7

*genotypes showing <45% and <15% deadhearts are considered as resistant to shootfly and stem borer, respectively.

TABLE 8
Reaction of HJH 1513 (SHH 1513) against major foliar disease in Station Hybrid Trial in Haryana under natural conditions

Traits	Year	HJH 1513 (SHH 1513)	HJ 541	HJ 513
Zonate leaf spot (1-9)*	*Kharif* 2019	1.2	1.4	1.4
	Kharif 2020	1.8	2.2	1.8
Mean		1.5	1.8	1.6
Sooty stripe (1-9)*				
	Kharif 2019	1.0	1.2	1.2
	Kharif 2020	2.8	2.8	2.2
Mean		1.9	2	1.7
Grey Leaf spot*	*Kharif* 2019	1.0	1.4	1.4
	Kharif 2020	1.2	2.0	2.2
Mean		1.1	1.7	1.8

*Foliar Disease (zonate leaf spot, sooty stripe and grey leaf spot) rating scale

Grade	Description	Reaction
1	No symptoms seen on the leaf and perfectly healthy	Highly resistant
2	1-5% of the leaf area is affected by spot	Resistant
3	6-10% of the leaf area is affected by spot	Resistant
4	11-20% of the leaf area is affected by spot	Moderately resistant
5	21-30% of the leaf area is affected by spot	Moderately resistant
6	31-40% of the leaf area is affected by spot	Susceptible
7	41-50% of the leaf area is affected by spot	Susceptible
8	51-75% of the leaf area is affected by spot	Highly susceptible
9	>75% of the leaf area is affected by spot	Highly susceptible

17.3 %, respectively (Table 7). This hybrid is resistant against major foliar diseases viz., grey leaf spot, zonate leaf spot, sooty stripe, anthracnose and leaf blight (Table 8).

Agronomy and Economics

This single-cut forage sorghum hybrid, HJH 1513 released and notified for cultivation in all sorghum growing areas of Haryana under timely sown, normal fertility level and irrigated conditions in *kharif* season (from 25 June to 10 July). Data presented in Table 3& 4 reveal that HJH 1513 has shown 12.33, 7.55 and 10.95 per cent increase for green fodder yield over CSV 21F, HJ 541 and HJ 513 respectively at F_3 fertility level *i.e*. 125% RDF. This hybrid has shown 90.9, 93.4 and 38.3, 49.3 per cent increase for fresh weight and dry weigh per plant over CSV 21F and CSH 13 respectively, at 8 ds/m salinity level (Fig. 3). This hybrid has shown 11.27 percent increase in green fodder yield over the state varietal check HJ 541 in the on-farm trials (OFTs) conducted during *kharif* 2020-22.

CONCLUSION

This is high biomass yielding single cut hybrid with good quality fodder. It can withstand salinity level upto 8 ds/m. It is tall, sweet, tan type having high concentration of total soluble solids and has low level of hydrocyanic acid with moderate tolerance against shoot fly, stem borer and resistant against major foliar diseases.

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