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Popularization of Var.HN-46 (Hagari Navane) under Rainfed conditions of Northern Karnataka

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Abstract
The front line demonstration on Popularization of Var.HN-46 (Hagari Navane) under Rainfed conditions of Northern Karnataka was conducted in 10 farmers' fields during *kharif* season during the year 2020-21 and 2021-22 at Muranpur village of Raichur taluk. The results of the front line demonstration (FLD) indicated that the new Foxtail millet Var. HN-46 recorded significant increase in yield upto 33.30 per cent with higher average grain yield of 21.10 q/ha, straw yield of 21.25 q/ha and Harvest index was 1.35 percent due to higher growth and yield prameters such as number of tillers (3.91 tillers plant^{-1}) and panicle length (21.10 cm), with respect to local variety HMT-100-1 number of tillers (2.92 tillers plant^{-1}) and panicle length (16.08 cm), grain yield 16.60 q ha^{-1}, straw yield 18.71 q/ha and Harvest index was 0.97 %. With respect to economics, the average cost of cultivation was 17638 Rs / ha with Gross returns of 60982 Rs / ha, net returns 43344 Rs / ha and the benefit cost ratio was 3.52 where as the average cost of cultivation of the check fields were 18306 Rs / ha with Gross returns of 45609 Rs / ha and net returns 27303 Rs / ha respectively. On an average the percent dead heart incidence observed lesser at demonstrated fields was 2.12 when compared to check fields recorded higher pest incidence 3.73.

Keywords: HN-46, Foxtail millet and Rainfed conditions

Introduction
Foxtail millet (*Setaria italica* (L.) Beauv) is an underutilized and neglected traditional crop that is hardy, climate resilent, highly nutritious which can grow well in rainfed and marginal lands of Karnataka. It is a self-pollinating crop with chromosome number, 2n = 18, classified under the family Poaceae. Millets are known for nutri-rich content and having characteristics like drought tolerance, photo-insensitivity and resilient to climate change. It is a matter of pride for all of us, that millets have now been recognized as superfood.

Millets have been called "Nutri grains" since they are rich in micro nutrients like minerals and B complex vitamins. Small millets have gained their attention owing to their inherent capacity of early maturity, higher yields due to C4 plant type, capacity to yield even in poor soil under low rainfall and poor management conditions; hence they are popularly known as "climate resilient" crops in Indian agriculture. Small millets provide much needed food and fodder security of the nation. Among minor millets, foxtail millet have low glycemic index. Consumption of these grains has demonstrated positive health benefits among the diabetics and they are known as "wonder grains". Foxtail millet can be planted when it is too late to plant most other crops. It keeps growing at 300 – 400 mm annual rainfall also in semi arid areas. In *Kharif* season millets are one of the cereals besides the major wheat, rice, and maize. Millets are major food sources for millions of people, especially those who live in hot and humid areas of the world. They are grown mostly in marginal areas under agricultural conditions in which major cereals fail to give substantial yields. Millets are important foods in many under developed countries because of their ability to grow under adverse weather conditions. Crop farming in the Arid and Semi-arid Lands (ASALs) is a big challenge due to factors such as the harsh climatic conditions experienced there, low adoption of improved drought tolerant crop varieties and limited farmer's knowledge on appropriate agricultural technologies. These factors contribute significantly to low food production, which leads to food insecurity persistently experienced in the ASALs, which

are home to about a third of the world's population.

Hence it was felt to know the potentiality of Var.HN-46 (Hagari Navane) wherein considerable improvement in yield of foxtail millet could be noticed. Therefore, the demonstration of Popularization of Var. HN-46 (Hagari Navane) under Rainfed conditions of Northern Karnataka was undertaken in the farmer's fields with the following major two objective:

- Popularization of Var.HN-46 (Hagari Navane) under rainfed conditions of Northern Karnataka by conducting front line demonstrations.
- To demonstrate substantial increase in yield and income of the farming families.

Methodology

Ten Farmers from Muranpur village were selected to implement demonstrations in their fields. Ten demonstrations were conducted wherein each farmer was given variety HN-46 as critical input so as to implement the demonstrations in their respective fields. Critical observations *viz*., panicle length, number of tillers, grain yield, straw yield and per cent increase in yield was worked out, and economic parameters like cost of cultivation, gross and net yield and B:C ratio were taken from each demonstrated farmers field. Farmers' feedback was also taken at the end of the crop period.

Results and Discussions

The field demonstration results of year 2020-21 revealed that significant differences were recorded between demo and check. Between two varieties, HN-46 (Hagari Navane) recorded significantly higher number of tillers plant^{-1} (3.60), panicle length (21 cm), grain yield (20.24), straw yield (19.89) when compared to local variety HMT-100-1 which recorded number of tillers plant^{-1} (2.50), panicle length (15.00 cm), grain yield (15 q ha^{-1}), straw yield (17.51 q ha^{-1}).

The demonstrated variety recorded the highest harvest index (1.20) whereas HMT-100-1 recorded the lowest harvest index (0.95) (Table 1). Difference in yields among the varieties could be attributed to their genetic potentiality to utilize and translocate photosynthates from source to sink. The results were in conformity with the findings of Saini and Negi (1996) [3], Munirathnam *et al*. (2006) [2].

Significant differences were recorded between the demo and check varieties of foxtail millet. The results of year 2021-22 revealed that among the two different varieties, HN-46 recorded significantly higher growth and yield parameters *viz*., tillers plant^{-1} (4.22), panicle length (21.19 cm), grain yield (18.20), straw yield (19.91) and percent harvest index (1.50) when compared to local variety (HMT-100-1) which recorded less number of tillersplant^{-1} (3.34), panicle length (17.16 cm), grain yield (15 q ha^{-1}) and straw yield (17.51 q ha^{-1}).

Among the demo and check varieties, the highest harvest index was recorded by HN-46 (Hagari Navane) (1.50) where as HMT-100-1 recorded the lowest harvest index (0.99) (Table 2).

Pooled data showed that the variety HN-46 recorded significantly higher number of tillers plant^{-1} (3.91), panicle length (21.10 cm), grain yield (21.10), straw yield (21.25) when compared to local variety (HMT-100-1) which recorded significantly lesser number of tillers per plant (2.92), panicle length (16.08 cm), grain yield (16.60q ha^{-1}) and straw yield (18.71 q ha^{-1}).

The highest harvest index was recorded by HN-46 (Hagari Navane) (1.35) where as HMT-100-1 recorded the lowest harvest index (0.97) (Table 3). The percent dead heart incidence observed lesser at demonstrated fields was 2.12 when compared to check fields recorded higher pest incidence 3.73.

Table 1: Growth, pest and yield parameters of foxtail millet (2020-21)

Particulars/Farmer	Demo(Foxtail millet variety HN-46)						Check (Local Foxtail millet variety HMT-100-1)					
	Number of tillers plant^{-1}	Panicle length (cm)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index	% dead heart incidence	Number of tillers plant^{-1}	Panicle length (cm)	Grain yield (q ha^{-1})	Straw yield	Harvest index	% dead heart incidence
Farmer 1	3.06	20.46	19.70	23.60	0.83	1.23	1.96	14.46	14.02	23.12	0.61	1.98
Farmer 2	3.26	20.66	19.90	10.64	1.87	1.65	2.16	14.66	14.42	10.89	1.32	3.76
Farmer 3	3.56	20.96	20.20	11.66	1.73	1.18	2.46	14.96	15.02	11.12	1.35	4.43
Farmer 4	3.16	20.56	19.80	23.93	0.83	1.52	2.06	14.56	14.22	14.12	1.01	6.65
Farmer 5	4.36	21.76	21.00	12.69	1.65	2.34	3.26	15.76	16.01	23.00	0.70	2.98
Farmer 6	3.96	21.36	20.60	27.29	0.75	2.21	2.86	15.36	15.12	11.12	1.36	2.65
Farmer 7	4.36	21.76	21.00	13.77	1.53	1.23	3.26	15.76	16.51	23.12	0.71	3.56
Farmer 8	3.06	20.46	19.70	12.96	1.52	2.07	1.96	14.46	14.52	24.12	0.60	4.32
Farmer 9	4.16	21.56	20.80	27.96	0.74	0.62	3.06	15.56	16.25	22.12	0.73	2.87
Farmer 10	3.06	20.46	19.70	34.38	0.57	2.09	1.96	14.46	13.94	12.36	1.13	3.89
Mean	3.60	21.00	20.24	19.89	1.20	1.61	2.50	15.00	15.00	17.51	0.95	3.71
SD	0.56	0.56	0.56	8.03	0.50	0.56	0.56	0.56	15.00	5.98	0.32	1.29
SEM	0.18	0.18	0.18	2.42	0.16	0.18	0.18	0.18	0.95	1.89	0.10	0.41
t-value	4.42	24.12	15.03	0.72	1.34	4.72	4.42	24.12	15.03	0.72	1.34	4.72
N	10	10	10	10	10	10	10	10	10	10	10	10

Table 2: Growth, pest and yield parameters of foxtail millet (2021-22)

Particulars/Farmer	Demo(Foxtail millet variety HN-46)						Check (Local Foxtail millet variety HMT-100-1)					
	Number of tillers plant^{-1}	Panicle length (cm)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index	% dead heart incidence	Number of tillers plant^{-1}	Panicle length (cm)	Grain yield (q ha^{-1})	Straw yield	Harvest index	% dead heart incidence
Farmer 1	3.98	21.72	22.98	29.65	0.54	0.65	1.87	16.82	16.89	24.21	1.45	2.45
Farmer 2	4.24	19.89	19.34	14.89	1.89	1.62	2.12	15.38	13.83	11.78	1.09	5.09
Farmer 3	4.76	17.54	21.29	18.98	2.09	1.07	3.90	18.94	18.32	12.01	1.14	2.65
Farmer 4	3.59	19.39	23.87	20.82	0.98	0.21	2.87	12.87	17.24	17.22	1.01	4.72
Farmer 5	4.09	20.04	22.98	18.34	2.87	1.22	2.84	22.43	18.32	26.09	0.98	2.87
Farmer 6	3.89	22.78	23.67	20.92	0.76	1.19	3.45	17.42	20.87	11.87	1.17	4.98
Farmer 7	5.09	25.76	19.89	17.78	1.98	1.04	4.67	15.81	17.67	23.81	0.32	5.01
Farmer 8	3.68	19.89	25.89	19.09	1.89	1.19	4.23	15.56	20.74	27.78	1.21	2.34
Farmer 9	4.98	22.98	21.65	25.80	1.08	0.84	3.56	16.39	18.32	26.43	1.13	4.54
Farmer 10	3.90	21.89	17.94	39.78	0.92	1.15	3.91	19.98	19.75	17.85	0.41	2.76
Mean	4.22	21.19	21.95	22.61	1.50	1.02	3.34	17.16	18.20	19.91	0.99	3.74
SD	0.54	2.33	2.40	7.36	0.75	0.38	0.91	2.70	2.06	6.51	0.35	1.21
SEM	0.17	0.74	0.76	2.33	0.24	0.12	0.29	0.85	0.65	2.06	0.11	0.38
t-value	2.63	3.56	3.76	0.87	1.95	6.81	2.63	3.56	3.76	0.87	1.95	6.81
N	10	10	10	10	10	10	10	10	10	10	10	10

Table 3: Growth, pest and yield parameters of foxtail millet (2020-21) (Pooled)

Particulars/Farmer	Demo(Foxtail millet variety HN-46)						Check (Local Foxtail millet variety HMT-100-1)					
	Number of tillers plant^{-1}	Panicle length (cm)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index	% dead heart incidence	Number of tillers plant^{-1}	Panicle length (cm)	Grain yield (q ha^{-1})	Straw yield	Harvest index	% dead heart incidence
Farmer 1	3.52	21.09	21.34	26.63	0.69	1.56	1.92	15.64	15.46	23.67	1.03	2.22
Farmer 2	3.75	20.28	19.62	12.77	1.88	2.46	2.14	15.02	14.13	11.34	1.21	4.43
Farmer 3	4.16	19.25	20.75	15.32	1.91	1.72	3.18	16.95	16.67	11.57	1.25	3.54
Farmer 4	3.38	19.98	21.84	22.38	0.91	1.63	2.47	13.72	15.73	15.67	1.01	5.69
Farmer 5	4.23	20.90	21.99	15.52	2.26	2.95	3.05	19.10	17.17	24.55	0.84	2.93
Farmer 6	3.93	22.07	22.14	24.11	0.76	2.81	3.16	16.39	18.00	11.50	1.27	3.82
Farmer 7	4.73	23.76	20.45	15.78	1.76	1.75	3.97	15.79	17.09	23.47	0.52	4.29
Farmer 8	3.37	20.18	22.80	16.03	1.71	2.67	3.10	15.01	17.63	25.95	0.91	3.33
Farmer 9	4.57	22.27	21.23	26.88	0.91	1.04	3.31	15.98	17.29	24.28	0.93	3.71
Farmer 10	3.48	21.18	18.82	37.08	0.75	2.67	2.94	17.22	16.85	15.11	0.77	3.33
Mean	3.91	21.10	21.10	21.25	1.35	2.12	2.92	16.08	16.60	18.71	0.97	3.73
SD	0.50	1.32	1.22	7.58	0.60	0.66	0.60	1.47	1.17	6.19	0.23	1.03
SEM	0.16	0.42	0.38	2.39	0.19	0.21	0.19	0.46	0.37	1.96	0.07	0.33
t-value	4.02	8.04	8.43	0.82	1.86	3.88	4.02	8.04	8.43	0.82	1.86	3.88
N	10	10	10	10	10	10	10	10	10	10	10	10

Economics analysis

Significant variations in grain and straw yields brought about variations in cost of cultivation, gross returns, net returns and BC ratio between demo and check during both the years of demonstration and also in pooled data.

During the year 2020-21 highest gross returns with 60,000 Rs./ha, net returns with 42,500 Rs./ha and 3.43 BC ratio with was obtained for improved HN-46 variety while farmers local variety recorded lower gross returns with 45,000 Rs./ha, net returns with 26,875Rs./ha and 2.50 BC ratio with were observed across the varietiesof foxtail millet (Table 4). The variations between the varieties in the economic returns may be attributed to the variable performance of HN-46 variety in terms of grain yield under improved practices in frontline demonstration. Higher returns and BC ratio under improved practices in frontline demonstration was also reported by Thakur *et al*., (2017) in finger millet crop, similarly higher net returns and B:C ratio in the FLDs on improved technologies compared to the farmers practices reported by Joshi *et al*., (2014) [1] in wheat.

During the year 2021-22, significantly higher gross returns with 61,964 Rs./ha, net returns with 44,187 Rs./ha and 3.61 BC ratio was obtained under improved HN-46 variety while farmers local variety recorded lower gross returns with 46,217 Rs./ha, net returns with 27731 Rs./ha and 2.54 BC ratio.

Between the two varieties, higher cost of cultivation was recorded with the variety HMT-100-1 (18306 Rs. ha^{-1}) compared to HN-46 (17638 Rs. ha^{-1}) on pooled mean basis.

Significant variations in grain and straw yields brought about variations in net returns gross returns and BC ratio between varieties during both the years of study and in pooled data.

Between the two different varieties, higher gross returns (60982 Rs. ha^{-1}), net returns (43344 Rs. ha^{-1}) and BC ratio (3.52) was recorded with the variety HN-46 when compared to HMT-100-1 which recorded gross returns (45609 Rs. ha^{-1}), net returns (27303 Rs. ha^{-1}) and BC ratio (2.52) on pooled mean (Table 5).

In conclusion, the grain as well as fodder yield under improved practices with HN-46 was recorded higher than the farmers' practices, which not only increased the yield per unit area but also enhanced the farmers' income. We also found a gap between demonstrated yields and farmers plot yields indicating that there is a need of proper dissemination of location specific technologies imbedded with high yielding varieties to improve productivity and profitability of rainfed farming of Raichur District.

Table 4: Economics parameters (2020-21)

Particular/Farmer	Demonstration				Check			
	COC (Rs/ha)	GR (Rs/ha)	NR (Rs/ha)	BCR	COC (Rs/ha)	GR (Rs/ha)	NR (Rs/ha)	BCR
Farmer 1	16370	54248	37878	3.31	19065	41328	22263	2.17
Farmer 2	18270	81128	62858	4.44	15765	51088	35323	3.24
Farmer 3	13970	44088	30118	3.16	17465	32448	14983	1.86
Farmer 4	18370	77688	59318	4.23	19765	59408	39643	3.01
Farmer 5	19670	30488	10818	1.55	17065	24688	7623	1.45
Farmer 6	17970	96968	78998	5.40	17465	78608	61143	4.50
Farmer 7	16370	51048	34678	3.12	18965	38848	19883	2.05
Farmer 8	19270	58568	39298	3.04	19765	42608	22843	2.16
Farmer 9	16070	43288	27218	2.69	19565	38608	19043	1.97
Farmer 10	18670	62488	43818	3.35	16365	42368	26003	2.59
Average	17500	60000	42500	3.43	18125	45000	26875	2.50

COC = Cost Of Cultivation, GR = Gross Returns, NR = Net Returns, BCR = Benefit Cost Ratio

Table 5: Economics parameters (2021-22)

Particular/Farmer	Demonstration				Check			
	COC (Rs/ha)	GR (Rs/ha)	NR (Rs/ha)	BCR	COC (Rs/ha)	GR (Rs/ha)	NR (Rs/ha)	BCR
Farmer 1	18342	35248	16906	1.92	19161	31323	12162	1.63
Farmer 2	18564	61462	42898	3.31	15425	41036	25611	2.66
Farmer 3	13456	85082	71626	6.32	17412	29426	12014	1.69
Farmer 4	18743	74681	55938	3.98	19763	48456	28693	2.45
Farmer 5	20523	32488	11965	1.58	17005	44688	27683	2.63
Farmer 6	18745	66968	48223	3.57	15422	74215	58793	4.81
Farmer 7	15678	70128	54450	4.47	18965	39657	20692	2.09
Farmer 8	18124	58562	40438	3.23	19785	42362	22577	2.14
Farmer 9	19245	63282	44037	3.29	19592	58635	39043	2.99
Farmer 10	16343	71734	55391	4.39	22325	52368	30043	2.35
Average	17776	61964	44187	3.61	18486	46217	27731	2.54

COC = Cost Of Cultivation, GR = Gross Returns, NR = Net Returns, BCR = Benefit Cost Ratio

Table 6: Economics parameters (Pooled)

Particular/Farmer	Demonstration				Check			
	COC (Rs/ha)	GR (Rs/ha)	NR (Rs/ha)	BCR	COC (Rs/ha)	GR (Rs/ha)	NR (Rs/ha)	BCR
Farmer 1	17356	44748	27392	2.62	19113	36326	17213	1.90
Farmer 2	18417	71295	52878	3.88	15595	46062	30467	2.95
Farmer 3	13713	64585	50872	4.74	17439	30937	13499	1.78
Farmer 4	18557	76185	57628	4.11	19764	53932	34168	2.73
Farmer 5	20097	31488	11392	1.57	17035	34688	17653	2.04
Farmer 6	18358	81968	63611	4.49	16444	76412	59968	4.66
Farmer 7	16024	60588	44564	3.80	18965	39253	20288	2.07
Farmer 8	18697	58565	39868	3.14	19775	42485	22710	2.15
Farmer 9	17658	53285	35628	2.99	19579	48622	29043	2.48
Farmer 10	17507	67111	49605	3.87	19345	47368	28023	2.47
Average	17638	60982	43344	3.52	18306	45609	27303	2.52

COC = Cost Of Cultivation, GR = Gross Returns, NR = Net Returns, BCR = Benefit Cost Ratio

Conclusion

The field demonstration results spanning 2020-2021 and 2021-2022 showcased significant disparities between demonstrated varieties, particularly evident in foxtail millet. HN-46 consistently outperformed the local variety HMT-100-1 across various parameters including tillers per plant, panicle length, grain and straw yield, and harvest index. Economic analysis underscored the superiority of HN-46, yielding higher gross returns, net returns, and benefit-cost ratio compared to the local variety. These findings emphasize the potential of improved practices coupled with high-yielding varieties to enhance both productivity and profitability in rainfed farming. Bridging the gap between demonstrated yields and farmer practices remains imperative for optimizing agricultural outcomes in Raichur District.

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