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Evaluation of black cumin genotypes for yield and yield related parameters in bale mid altitude, southeastern Ethiopia

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ABSTRACT

Fourteen black cumin genotypes were evaluated against standard checks for two consecutive years during 2018 to 2019 at Sinana, Goro and Gindhir to investigate high yielder and stable black cumin varieties. The mean total seed yield of genotypes across environment ranged from 24.54 to 16.07 Qt ha⁻¹. The highest total seed yield was recorded from genotypes 242826-2 followed by 242826-2 (24.54 and 23.32 Qt ha⁻¹) while the lowest total seed yield was obtained from local checks. These two genotypes have yield advantage of 22.41 and 14.96% over standard check Derbera. Based on their performance across location over standard checks these two genotypes will be promoted for variety verification for Bale mid altitude and similar agro ecologies.

Keywords: Black cumin, Genotype, Oleoresin content.

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Introduction

Black cumin, *Nigella sativa* L. is an annual herbaceous plant belonging to the family Ranunculaceae (Hammo, 2008). Its seed constituents have unique chemical properties with more than one hundred different chemical components (Bardideh *et al.*, 2013). The Ethiopian variety of black cumin seed accumulate up to 50% thymol, a monocyclic phenolic compound which make valuable source for healthcare (Merga Jibat *et al.*, 2018). Black cumin is used principally to flavor food, either as whole grain, in powdered form or as an oleoresin extract (Black *et al.*, 2006). Within Ethiopia, its main use is as a spice, which is typically ground and mixed with other spices. There is also some use in traditional medicine (Aminpour and Karimi 2004). The vast majority of Ethiopia's black cumin exports go to Arabic countries, which together with other predominantly Muslim countries.

Moreover, the production and land coverage of black cumin in Bale mid altitude have been increasing while the productivity is still less than national average 1.7 ton per hectars (Girma *et al.*, 2008). In Bale mid altitude, highland seed spices

viz., black cumin, fenugreek and coriander are produced widely. About 42,000 ha of black cumin produced per year both in "Gena" and "Bona" cropping season in Bale districts (Goro, Ginnir, Golocha and some part of Sawwena and Sinana. Due to increased demand of black cumin seed for local consumption and other importance, such as oil and oleoresin for medicinal purposes, its export market, its potentiality in crop diversification, income generation and its importance to reduce the risk of crop failure and others made black cumin as a best alternative crop under Bale mid altitudes. But, the yield of black cumin in these areas is not as much as the potential of the crop due to many factors among which lack of high yielder and stable varieties are the majors. Hence, developing an improved variety, after screening of lines/accessions with desirable traits, of these crops is one of the immediate measures to be taken. Accordingly, this activity was initiated to evaluate and identify the genotypes of black cumin that are high yielding and tolerant to major disease in mid altitudes of Bale, southeastern Ethiopia.

Materials and Methods

Fourteen black cumin genotypes were evaluated against standard (Derbera, Dirshaye and Eden) and local checks for two consecutive years during 2018 to 2019 under rain-fed conditions at Sinana, Goro and Gindhir. The areas possess a bimodal rainfall type. This bimodal rainfall system has created favorable condition to produce crops twice annually or double crop production season.

The experimental trial was laid out in a Randomized Complete Block Design (RCBD) with three replications. Each variety was planted in four rows at spacing of 30 cm between rows 2.4 m². Fertilizer application was made as per the national recommendation made for the crop which is 100 kg ha⁻¹ and the whole rate was applied at planting. Mean yield and disease score of genotypes will be computed using GENSTAT 15th edition.

Results and Discussion

The mean total seed yield of genotypes across environment ranged from 24.54 to 16.07 Qt ha⁻¹. The highest total seed yield was recorded from genotypes 242826-2 (24.54 Qt ha⁻¹) followed by 242826-2 (23.32 Qt ha⁻¹) while the lowest total seed yield was obtained from local checks. These two genotypes have yield advantage of 22.41 and

14.96% over standard check Derbera. The mean for capsule number per plant, biomass and primary branch was ranged from 10.72 to 6.96, 63.74 to 39.79 and 4.67 to 3.33 (Table 2). The highest number of capsule per plant (10.72), biomass (63.94 t ha⁻¹) and primary branch (4.67) were recorded from genotypes 242826-2 followed by genotype 205167-2. This implies agronomic parameters were contributed directly or indirectly to total seed yield for black cumin. Similar findings were reported previously by [Girma *et al.* \(2016\)](#) and [Fufa \(2016\)](#) who indicated black cumin seed yield is positively correlated with plant height, number of capsules per plant, number of primary branches per plant, and number of seeds per capsule. Days to maturity and days to flowering were ranged from 144.83 to 128.00 and 90.00 to 80.00, respectively. Genotype 242826-2 has two weeks early maturing which is used for scape forcing maturity due to shortage of rainfall mostly occurs in the study area.

The highest means of total seed yield was recorded from Ginnir (23.57 Qt ha⁻¹) followed by Sinana (21.77 Qt ha⁻¹). This may be due to potential of the district for black cumin production than both sampled environment.

Table 1. Means of seed yield (Qt ha⁻¹) of 14 black cumin genotypes across location and years.

Genotype	Ginnir		Goro		Sinana		Grand Means
	2016	2017	2016	2017	2016	2017	
205167-2	26.55	26.60	18.60	19.35	24.05	24.80	23.32
207540-2	22.63	22.68	14.68	15.43	20.13	20.88	19.41
208688-1	24.99	24.94	17.04	17.69	22.49	23.14	21.72
242826-2	28.46	27.13	20.51	19.88	25.96	25.33	24.54
242842-1	20.92	22.94	12.97	15.69	18.42	21.14	18.68
90510-2	24.41	24.46	16.46	17.21	21.91	22.66	21.18
90514-2	21.66	23.57	13.71	16.32	19.16	21.77	19.36
90516-2	23.16	23.88	15.21	16.63	20.66	22.08	20.27
90575-2	23.45	23.50	15.50	16.25	20.95	21.70	20.23
910619-2	17.78	23.28	9.83	16.03	15.28	21.48	17.28
Derbera	22.48	22.81	14.53	16.39	19.98	21.01	19.53
Dirshaye	19.62	22.00	11.67	14.75	17.12	20.20	17.56
Edan	21.83	21.74	13.88	14.49	19.33	19.94	18.53
Local	18.16	20.49	10.21	13.24	15.66	18.69	16.07
Mean	22.58	23.57	14.63	16.38	20.08	21.77	19.83
CV	4.3	9.5	6.7	14.1	4.9	10.3	18.70
LSD	1.79	3.75	1.63	3.88	1.63	3.75	2.43

Table 2. Summary of mean yield and other agronomic traits on the two promising black cumin genotypes selected as candidate for release and checks in regional variety trial over the six environments.

Genotypes	DF	DM	PH	PB	SB	CPP	BMTH	SY
205167-2	81.58	135.50	50.90	4.44	2.17	9.22	58.89	23.32
207540-2	88.25	140.17	58.90	3.33	0.61	7.17	51.48	19.41
208688-1	82.58	133.50	51.23	3.72	2.61	7.17	55.14	21.72
242826-2	90.92	144.83	58.90	4.61	3.44	10.72	63.94	24.54
242842-1	80.58	128.50	49.90	4.28	1.44	8.56	39.79	18.68
90510-2	89.58	133.50	55.57	4.61	1.44	8.61	43.06	21.18
90514-2	80.58	129.50	50.23	4.67	1.78	8.56	50.33	19.36
90516-2	81.58	134.50	56.57	3.78	1.50	8.67	48.50	20.27
90575-2	86.58	143.50	57.57	4.56	1.17	8.61	49.28	20.23
910619-2	86.58	138.50	58.90	4.28	0.94	7.28	44.51	17.28
Derbera	81.58	138.50	48.57	4.17	1.72	8.94	43.17	19.53
Dirshaye	83.58	137.50	49.23	3.72	1.50	8.78	42.55	17.56
Edan	83.58	133.50	50.90	4.22	0.56	6.94	49.94	18.53
Local	84.58	133.50	49.90	4.11	2.11	7.33	43.21	16.07
Mean	84.44	136.07	53.38	4.18	1.64	8.33	48.84	19.83
CV	6.90	4.90	7.60	22.00	35.00	14.00	11.10	18.70
LSD	3.80	4.33	2.70	0.60	0.37	0.80	3.55	2.43

Note: DF=days to flower, DM=days to maturity, PH=plant height, PB= primary branches/plant SB=secondary branches/plant, CPP=Capsule/plant, BMTH= biomass mass ton per hectare, and SY= seed yield Quintal per hectare.

Conclusion and Recommendation

The yield performance of two genotypes 242826-2 and 205167-2 across environment and yield advantage of both genotypes over standard checks were 22.41 and 14.96%, respectively. This suggested that, both genotypes were promoted for variety verification for Bale mid altitudes and similar agro ecologies.

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