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Research Article

Release and Registration of *"Hundaol"* Intermediate Maturing Type of Cowpea (*Vigna Unguiculata* (L.) Variety for Mid and Lowland of West Hararghe, Oromia, Ethiopia

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Abstract

Hundaol" is a name given for the cowpea variety with accession number ILRI#25368 developed and released variety for dual-purpose (grain seed and forage) production for low and mid-altitude areas of West Hararghe. "Hundaol" was tested at Mechara Agricultural Research Center on station, Milkaye farmer training center, and Melkasa Agricultural Research Center Mieso sub-site for two years from 2019- 2021 with nine other genotypes and two standard checks. Hundaol variety was sown with a seed rate of 30kg/ha, 100 kg/ha NPSB, and 50 kg/ha urea fertilizer rate, which was applied at a sowing time with a space of 30 cm between rows. "Hundaol" was selected for its best seed yield, highest dry matter yield, disease and pest tolerance, and stable performance across the locations. "Hundaol" was verified at on station and the farmer's field level during the variety verification trial in 2023 with the newly released standard check "Qophee" variety. "Hundaol" produced 9.68 t/ha dry matter yields that have yield advantages of 12.30% and 89.25% over White Wonder and Kenketi standard checks, respectively. It produce an average seed yield of 23.28 qt/ha. On average, "Hundaol" variety has 118.86 cm plant height, 15.3cm, 13.2, and 12.90 pod length, number of pods per plant and seed per pod respectively, needs 67.61 days to reach 50% of flowering, 108.67 days to reach seed maturity. Similarly, the experimental farmers gave the first rank for the "Hundaol" variety rather than the standard check "Qophee" variety. So, the introduction of these newly released forage varieties could help alleviate the feed by small-scale farmers in West Hararghe and other parts of the country.

Keywords

Cowpea, Dry Matter, Hundaol, Variety, West Hararghe

1. Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is grown in tropical Africa, Asia, North and South America mostly as a grain, vegetable and fodder crop. It is favored because of its wide adaptation and tolerance to several stresses. It is an

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important food source and is estimated to be the major protein source for more than 200 million people in sub-Saharan Africa [10]. It is an annual herbaceous legume that belongs to Fabaceae family and widely cultivated and consumed grain legumes globally, especially in the arid and semi-arid tropics [1, 9]. Cowpea has been produced mainly for its protein rich pulse, popularly consumed with starchy staple foods [8]. Farmers desire varieties that display temporal stability, that is, performing consistently from year to year as opposed to varieties that perform consistently from location to location (spatial stability) [7, 11]. Cowpea plays a fundamental role in the human diet in many developing countries and is being referred to as "poor-man's meat" [13]. The grain of cowpea is highly nutritious and contains about 15.06 -38.5% protein [13] and 50-60% carbohydrates [4].

Cowpeas vary in growth habit from erect or semi-erect types with short (<100 days) growth duration, grown mostly for grain, to longer (>120 days) duration in semi-erect to trailing plants which are normally grown primarily for forage [12]. It is one of the lowland legumes grown for food, cash crop and medicinal purposes in the different growing areas of Southern Ethiopia [15]. It is ranks the 5th to 9th important legume crop for household food, nutrition, and income generation for cultivating farmers, which contributes significantly to food security of the southern region of Ethiopia ([15]. Generally, cowpea production and utilization in Ethiopia is very low as compared to other African countries though the country is claimed to be the center of diversity and/or origin. The country has high potential for the production of the crop as more than 66.5% of the arable land is very suitable for cowpea production (Collaborative Crop Research Program [2].

West Hararghe has a suitable agro ecology that helps the production of cowpea. The region has the indigenous knowledge of practicing livestock fattening using different improved forages like Desho grass, Braccharia, Rhodes grass, Napier grass, Cowpea and Alfalfa. Even though thus improved forages are introduced and popularized, searching new varieties that produces higher quality and quantity is very important. Among the quality forage type cowpea could play an important role in providing a significant amount of quality forage, both for the smallholder farmer as well as intensive livestock production systems with appropriate management practices. Hence, the current research is initiated with the objective to release and register top performing cowpea variety in major agronomic traits, best nutritional quality and stable for in the study area.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in West Hararghe zone one mid land (Daro Labu) and one low land (Mieso) district for one year of the main cropping season (2023) for variety verification trial.

Daro Labu district is located at latitude of 40°30′ E and 8°10′ N. The district is located at 434 km and 111km to East of capital city of the country, Addis Ababa and Chiro, capital city of the zone respectively. The major soil texture of the district is sandy loam with reddish color. The ambient temperature of the district ranges from 15 ℃ to 28 ℃ with the average of 21 ℃ and average annual rainfall of 1120 mm/year [14]. The predominant production system of the district is mixed livestock-crop production system. The major crops growths in the study area are maize, sorghum, haricot bean, ground nut, sesame and finger millet. Most tree fruits like mango, banana, orange, lemon, hot paper and Avocado also the common one. The especially coffee is the brand crop of the study area known as Hararghe *coffee spatiality*. The major livestock feeds are crop residue (40.67%), green fodder (33.42%), hay (6.65%), by product 2.81%), others and improved forages are (14.71%) and (1.74%) respectively [3]. Among improved livestock feeds, Napier grass, Cowpea, Bracharria and Desho grass are widely used as livestock feed. Major livestock species are cattle, goat, donkey, poultry camel and sheep.

Mieso is located 300 km east of Addis Ababa at about 25 km from Chiro the zonal capital city. Geographically, the district is located between 40°9 30.1 and 40°56 44"E, and 9°19 52 N; and 8°4812"N [6]. The altitude is ranges from 1107 to 3106 m above sea level (masl). The mean maximum and mean minimum temperature is 31 ℃ and 15 ℃ respectively with the mean annual temperature of 23 ℃, while average annual rainfall 761 mm [14]. According to FAO/UNESCO soil classification system, the major soils of the district are Vertic Cambisol (orthic and ferralic), Haplic Luvisol (Orthic) and Eutric Cambisol (Orthic), accounting for 50%, 16% and 11%, respectively. The major agricultural activity is livestock raring since it is categorized under one of pastoralist area in the West Hararghe zone. The main livestock reared in the study area are cattle, goat, camel, poultry, donkey and in rear manner sheep. Crop residue is the main livestock feed in the study area. Nowadays, the community shift to produce crops like sorghum, maize, sesame, Haricot bean, ground nut, fruit and vegetables like banana, mango and onion.

2.2. Experimental Design and Layout

A total of six locations were sown to verify the cowpea genotypes. One candidate cowpea genotype and one newly released standard check considered for this study with "Qophee" variety as standard check. The candidate genotype and newly released was planted in 10 m x 10 m plot size and 30cm between the rows. The seed rate was used 30kg/ha with fertilizer rate 100 kg/ha NPSB and 50 kg/ha of urea fertilizer were applied at a sowing time. The seed was sown through hand drilling techniques.

2.3. Data Collection and Measurements

Most important agronomic data like flowering date, maturity date, plant height, plot cover, disease reaction and occurrence, grain yield data were collected. Also farmer preferences data were collected.

2.4. Statistical Analysis

Agronomic data and farmers preferences were compared by simple descriptive statistics like means and standard deviation.

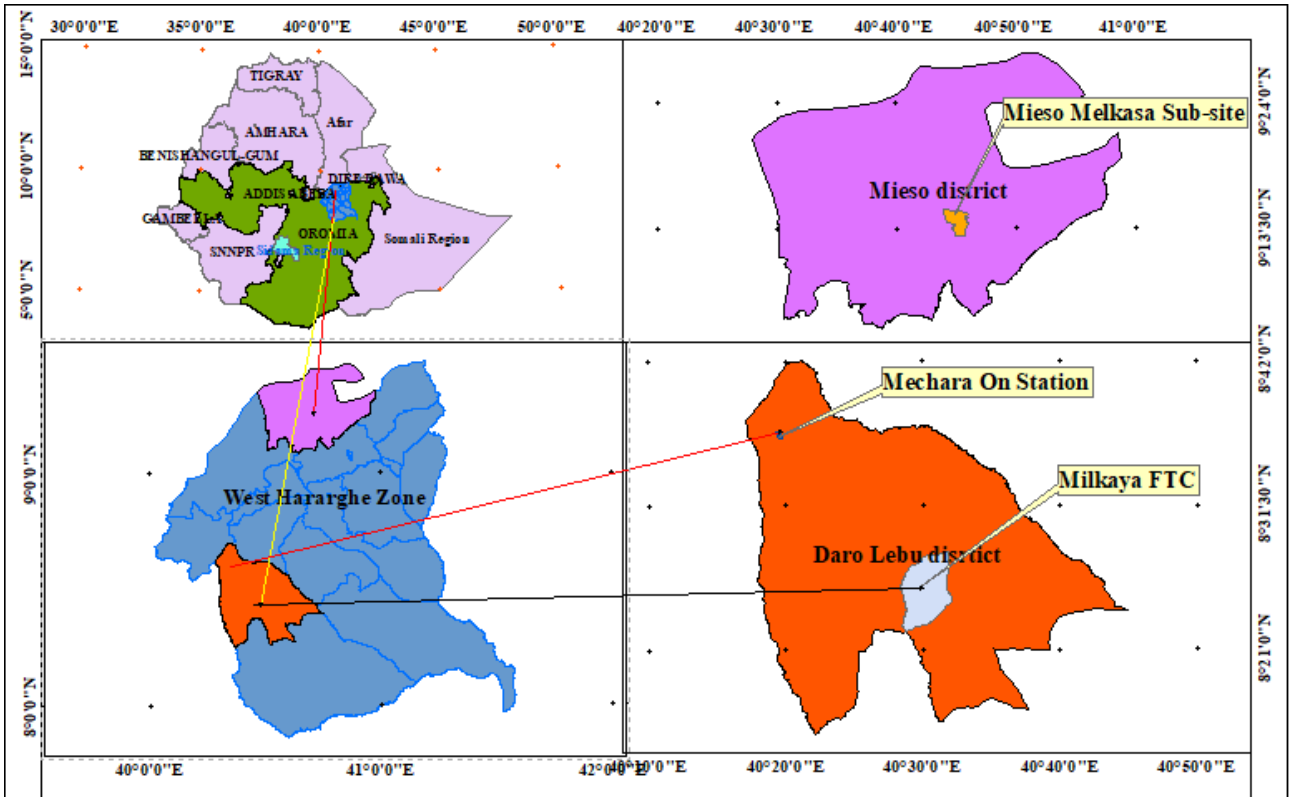

Figure 1. *Map of study area.*

3. Results and Discussions

3.1. Genotypes Origin and Evaluation

"Hundaol" (ILRI#25368) is an intermediate maturing cowpea variety developed by Mechara Agricultural Research center for low and mid land of West Hararghe zone and other similar agro-ecologies of the countries. At the initial, "Hundaol" (ILRI#25368) and 179 genotypes of cowpea were collected from the International Livestock Research Institute (ILRI) to evaluate the growth characteristics, agronomic trait, diseases and insects reaction during observation nursery at Mechara Agricultural Research Center during 2018 cropping season. Then 34 genotypes cowpea were promoted to the preliminary variety trial during 2019. During this step, the genotypes were evaluated for their herbage yield, seed yield and reaction to diseases and insect. From the result of preliminary yield trial, 10 (ten) superior genotypes were passed to regional variety trial which were evaluated at multi location (Mechara on station, Milkaye FTC and Mieso Melkasa Agricultural Research Center sub-site) along with two checks for two years (2019/20 – 2021/22). The checks were White Wonder and Kenketi varieties. From 10 genotypes, ILRI#25368 (Hundaol) was further selected to promoted for variety verification trials. Genotype ILRI#25368 (Hundaol) and standard check (Qophee) were planted in 2023 on 10m x 10m =100m^2 plots at six locations. The national variety releasing committee evaluated the varieties under field condition. Finally, Hundaol variety were confirmed and released as intermediate maturing cowpea variety for low and mid land areas of West Hararghe zone and similar agro-ecologies of the Ethiopia.

3.2. Varietal Characters and Adaptation

The released variety, "Hundaol" is characterized by growth habit of semi-erect and moderate leaf size. Seed color of "Hundaol" is creamy-white. On the average, "Hundaol" needs 67.61 days to reach 50% of heading/flowering and 108.67 days to reach seed maturity stage. "Hundaol" variety

had plant height on average of 118.86 cm at physical maturity of harvest (Table 1). The variety also produced on average 13.2 numbers of pod per plant, on average 15.3cm pod length and 12.90 seed per pod (Table 2). Hundaol variety is released for the low and mid land of West Hararghe and performed well within an altitude from 1350 -1800 meters above mean sea level.

3.3. Herbage Dry Matter and Seed Yield Performance

The average dry matter yield of hundaol variety was 9.68t/ha and the standard checks (White Wonder and Kenketi) produced 8.87 t/ha and 5.21 t/ha respectively during multi location variety trial. Hundaol variety produced dry matter yield advantages of 12.30% and 89.25% over White Wonder and Kenketi standard checks varieties respectively. The variety also recorded the highest seed yield of 23.28 qt/ha, outperforming the White Wonder and Kenketi standard checks by 12.58% and 32.05%, respectively (Table 1). During variety verification trial, Hundaol variety was evaluated with recently released variety (Qophee). Hundaol variety produced on average 24.98 qt/ha while Qophee variety produced 20.31 qt/ha which has yield advantage 22.99% over "Qophee" variety (Table 2). According to [5] regression model, Hundaol variety can be considered as more stable than other tested genotypes. The GGE biplot analysis as indicated to Figure 1 that, the released variety, Hundaol fall to near to the concentric circle to the average environment axis which indicates that, it is ideal genotype in terms of yielding ability and stability.

3.4. Quality Parameters

Data on the nutritional content of the variety indicated that the Hundaol variety had best crude protein contents of (18.62%), in vitro organic matter digestibility (IVDMD) 61.67% and comparatively lower Neutral detergent fiber (NDF) and acid detergent fiber (ADF) which is 44.07% and 35.65% respectively compared to the tested genotypes. The released variety also produced lower total ash content which was 12.25% (Table 3).

3.5. Reaction to Diseases and Insects

The most common diseases of Cowpea are Fungal, bacterial and viral diseases. On 1-5 rating scale, Hundaol, White Wonder and Kenketi scored a mean of 1.17, 1.5 and 2.33 for Cercospora (leaf spot) which indicate that Hundaol variety is more tolerant variety than the others. Insects were not observed on candidate variety during the experiment duration (Tables 2 and 3). Hence, the released varieties are characterized by more tolerant to the major diseases at all sites.

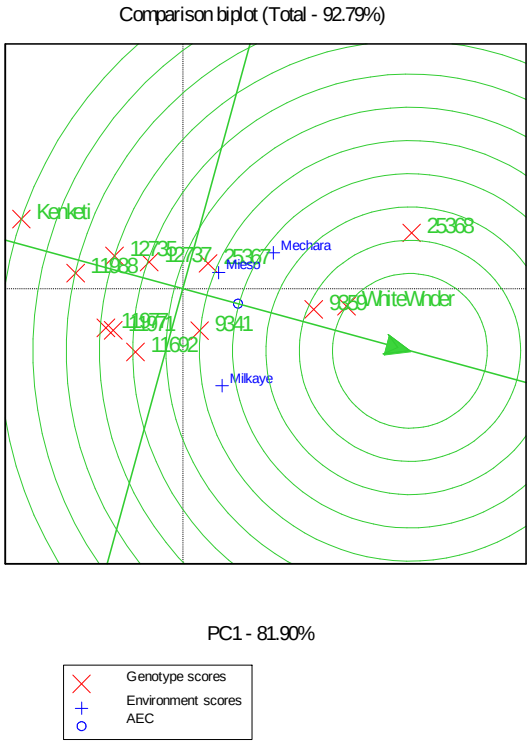

Figure 2. *GGE bi-plot for comparison of genotypes for their yield potential and stability.*

3.6. Farmers Preferences

Farmer's preferences were collected for plot cover, biomass yield, stand vigor, leafiness and maturity dates from five experimental farmers of experimental site and three developmental agent workers. The farmers and DA" s were evaluated through visual observation and hand evaluation. The result indicates that the perceived degree of importance of Hundaol variety was ranked first based on the above criteria's. Accordingly, the average rank showed that farmers and DA" s gave the first score for Hundaol variety than the standard check (Qophee) in terms of plot cover, biomass yield, leafiness and stand vigor. The candidate variety was not selected only by maturity date because of its lateness than the standard check (Table 4).

Table 1. *Mean agronomic performance of cowpea genotypes during multi location test.*

Genotype	DE	PC	D50F	LSR	PH cm	DI	Pest	MD	DMYtha	SYquha
KK	5.67	67.56	49.33	0.68	72.22	2.33	2.78	110.72	5.21	17.69
11692	5.39	83.78	60	0.75	72.41	1.72	1.89	120.89	6.79	18.08
9341	5.17	83.94	65.56	0.68	95.21	1.5	1.67	119.28	7.72	14.05
25368	5.06	92.22	67.61	0.76	118.86	1.17	1.78	108.67	9.68	23.28
11971	5.67	83.06	57.28	0.69	100.09	2.17	2.11	113.39	6.41	20.8
9359	5.56	85.28	65.28	0.78	105.22	1.44	1.11	124.67	8.57	18.79
11977	5.5	90.33	59.5	0.67	107.69	1.72	2.22	114.72	6.8	21.86
12735	5.22	83.89	57.28	0.60	61.74	2.06	1.39	117.61	6.1	20.33
WW	5.83	86.28	62.83	0.66	93.97	1.5	1.44	119.22	8.78	20.75
12737	6.17	73.78	64.61	0.78	81.14	1.5	1.67	120.5	6.64	18.26
25367	5.06	91.11	69.5	0.67	105.07	1.22	1.44	119	7.45	17.75
11988	5.56	81.56	51.89	0.71	96.89b	2.44	1.89	117.17	5.92	23.3
Mean	5.48	83.56	60.87	0.7	92.54	1.75	1.78	117.15	7.18	19.75
Genot	***	***	***	NS	***	***	***	***	***	***
Env'nt	***	***	***	***	***	NS	**	***	***	***
G*E	***	***	***	*	*	NS	***	**	**	NS
G*E*Y	***	**	***	*	**	***	NS	***	*	***
CV	9.49	12.99	10	26.88	22.99	45.68	35.82	5.45	34.13	32.79
LSD (%)	0.34	7.15	4.01	0.12	14.02	0.53	0.42	4.25	1.61	4.18

KK= Kenket, WW = White Wonder (standard checks), DE = date of emergency, PC = plot cover, D50F = dte of 50% flowering, LSR = leaf stem ratio, PHcm = plant height in cent meter, DI = diseases incidence, DM = maturity date, DMYtha = dry matter yield tone per hectare, SYquha = seed yield quintal per hectare

Table 2. *Mean agronomic performance with "Qophee" variety during variety verification.*

Geno	PC	DI	FD	PH	Br	NPOD	PL	SPP	MD	FBMtha	Syqt/ha	Sy adv (%)
Qophe	94.67	1.17	64.17	88.03	7.23	9.27	15.37	11.73	106.50	43.28	20.31	22.99
25368	97.50	1.17	67.83	107.6	7.97	13.20	15.27	12.90	108.67	57.72	24.98	
Mean	96.08	1.17	66	97.82	7.60	11.23	15.32	12.32	107.58	50.50	22.65	

Geno= Genotypes, PC= plot cover, DI = Disease Incidence, FD = 50% flowering date; PH = plant height, Br=Branch per plant, PL =Pod length, SPP = seed per pod; MD = Maturity date; FBMtha = Fresh biomass tone per hectare, Syqt/ha = grain yield per hectare, Sy adv(%) = seed yield advantage in percent.

Table 3. *Chemical composition of cowpea genotypes.*

Genotype	%DM	Ash	CP	NDF	ADF	ADL	IVDMD
KK	92.67	13.48	18.21	45.4	37.02	6.83	60.16

Genotype	%DM	Ash	CP	NDF	ADF	ADL	IVDMD
11692	92.64	13.69	18.22	45.81	37.68	6.95	59.91
9341	92.79	12.54	18.02	45.32	35.22	6.64	61.67
25368	92.87	12.25	18.62	44.07	35.65	7.02	61.67
11971	92.75	13.17	18.22	45.63	37.19	6.98	60.60
9359	92.94	12.82	17.54	45.68	36.7	7.01	60.31
11977	92.88	12.96	17.69	46.03	36.95	6.89	61.28
12735	92.70	13.46	18.47	44.46	35.51	6.68	60.71
WW	92.73	13.39	18.31	45.09	36.82	7.03	60.17
12737	92.91	13.40	17.93	47.2	38.73	7.08	60.12
25367	92.69	13.22	18.16	45.36	36.77	6.97	60.77
11988	92.67	12.88	17.54	45.49	36.3	8.82	60.92
Mean	92.77	13.11	17.99	45.71	36.88	6.91	60.61
CV	0.18	7.95	5.15	4.05	5.86	4.82	2.58
LSD (%)	0.29	1.76	1.57	3.14	3.66	0.56	2.65
P-Value	NS	NS	NS	NS	NS	NS	NS

DM = Dry Matter; CP = Crude Protein; NDF =Neutral detergent fiber; ADF = Acid Detergent Fiber; ADL = Acid detergent lignin; IVDMD = In vitro Dry Matter Digestibility;

Table 4. *Farmer preferences Result.*

Location (Farmer)	Genotype	plot cover	Biomass yield	Leafiness	stand vigor	Maturity Date
On station	ILRI#25368	1	1	1	1	2
Mieso (MARC)	ILRI#25368	1	1	1	1	2
Sara	ILRI#25368	1	1	1	1	2
Sakina FTC	ILRI#25368	1	1	1	1	2
Getachow	ILRI#25368	2	2	1	2	1
Yusuf	ILRI#25368	1	1	1	1	2
Sum		7	7	6	7	11
Average (mean)		1.17	1.17	1	1.17	1.83
On station	Qophe	2	2	2	2	1
Mieso (MARC)	Qophe	2	2	2	2	1
Sara	Qophe	2	2	2	2	1
Getachow	Qophe	1	1	2	1	2
Sakina FTC	Qophe	2	2	2	2	1
Yusuf	Qophe	2	2	2	2	1
Sum		11	11	12	11	7
Average (mean)		1.83	1.83	2	1.83	1.17

1 = first, 2 = second, MARC = Melkasa Agricultural Research Center mieso sub-site, FTC = farmer training center.

Table 5. *Agronomic/morphological characteristics of cowpea variety, Hundaol (ILRI#25368).*

Characteristics	Description
Species	*Vigna unguiculata (L.)*
Variety Name	Hundaol
Adaptation area	Mechara, Mieso and similar agro ecologies
Altitude(m.a.s.l)	1350 - 1800
Rainfall(mm)	550 – 950
Fertilizer rate	
Nitrogen(kg N ha-1)	23
NPS(kg P2O5 ha-1)	46
Fertilizer application time	At sowing stage
Fertilizer application method	Row drilling
Planting or seeding	Row drilling
Planting date	Early July
Seed rate(kg ha-1)	30
Row spacing(cm)	30
Plant spacing(cm)	Drilling
Days to flowering (days)	49 to 79
Days to Maturity (days)	85-118
Plant height(cm)	108 - 140
Leaf to stem ratio	0.76
Seed color	Creamy-white
Crop pest reaction(1-5 scale)	
Cercospora leaf spot	1.17
Dry matter yield (t/ha)	9.68
Fodder Quality (%)	
DM	92.87
CP	18.62
IVOMD	61.67
Ash	12.25
NDF	44.07
ADF	35.65
ADL	7.02
Special merit	Dual purpose
Yield(Qt ha-1)	
Research field	18.33 - 29.5
Farmers" field	14 - 23
Year of release	2023
Breeder seed maintainer	Mechara Agricultural Research Center

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Authors' Contributions

Tamrat Dinkale, the corresponding author, was responsible for all aspects of the study, including data collection, data analysis, and manuscript writing. Muleta Debela and Birmaduma Gadisa were contributed during proposal development; Lensa Urgesa and Jibrail Hassan were contributed during data collection and contributed to the improvement and finalization of the text, as well as reading and approval of the final edition.

Data Availability

The Data used to support the findings of this study are available from the corresponding author upon request.

Disclosure

No potential conflicts of interest were reported by the authors.

Conflicts of Interest

The authors declare no conflicts of interest.

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