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Result of Turmeric Variety Trial in Ethiopia

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Abstract: *Eight turmeric genotypes including the released variety "DAME" from the germplasm held at Tepi National Spices Research Center, Ethiopia, were evaluated during the season of 2014-2016 at six locations in order to select high yielding, stable and good quality turmeric cultivars for release. At each location, the experiment was laid out in RCBD in three replications. From the result HT3/2002 were surpass both the accessions evaluated in plant height, leaf width, leaf length, tillering ability, rhizome length and width as well as fresh rizome yield and dry recovery percentage, whereas, Dame the released variety were found poor performance in all location, HT3/2002, were perform good in all location except at Areka, whereas other genotype were found poor performance at Bebeka, Metu, and Wolkite University locations and Tepi and Jimma locations are best for turmeric production. Oleoresin content were found different in the variety and location evaluated, which is ranged from HT2/2002 (7.68) at Tepi to Bonga 51/71 (5.77) at Bebeka.. The effect of location on all attributes was significant (P < 0.05) with Welkite location giving consistently the least values for all attributes thus suggesting that this location may not be suitable for the commercial production of turmeric. Genotype by environment interaction for most attributes was not significant indicating that the genotypes responded the same way across the locations. Two genotypes, viz., HT3/2002 and BONGA (51/71) are identified have been found promising and evaluated by variety evaluating committee for official release.*

Keywords: *Turmeric, genotypes, variation, rhizomes, yield.*

1. INTRODUCTION

Turmeric is the dried rhizome of *Curcuma longa L., herbaceous plant* and native *of* South Asia. It is grown in tropical countries *viz., Ethiopia, India, Pakistan, Myanmar, Chile, Peru,* , etc., Turmeric (*Curcuma longa*.) is One of exported spice in Ethiopia, Southwest Ethiopia produce this spice as a cash crop and many lively hood had been depend on it for a living. India is the world biggest exporter and producers of turmeric, whereas, Ethiopia is the biggest exporters and producers of turmeric in Africa (Chaudhary *et al*., 2006). India imported Turmeric worth USD 4,635,094 from Ethiopia with total quantity of 4,226,910. With Average price of per kg is USD 1.10everyyear

(http//ImportDataandPriceofturmericfinger_Zauba.html).

Turmeric has a characteristic flavor and yellow in color. It is used in culinary preparations, in cosmetics (facial preparation and creams) and ayurvedic drug preparations, antiseptic and also anti-inflammatory. Turmeric introduced to Ethiopia in 1970's by Tepi national spices research center (TNSRC). TNSRC has commenced several research experiments and developments since the introduction of the crop with the objective of identifying best turmeric production and processing technologies and practices that could serve as the best alternatives crop for export diversification and alleviation of poverty in the country.

In addition to the rhizome's richness in curcuminoid pigments (6%) and essential oils (5%), it also contains 69.43% carbohydrate, 6.30% protein, 3.50% mineral and other important nutrients on dry weight

basis (Olojede *et al*., 2005). The increasing demand for natural products as food additives makes turmeric an ideal produce for a food colorant. Additionally, anti-cancer and anti-viral properties of turmeric may also increase its demand from the pharmaceutical industry.

Turmeric production in Ethiopia mainly concentrated at southeast part of the country (Sheka, benchmaji and keffa zones) however, recently major ginger producing areas including Wolayta zone shifts the land to turmeric production because of ginger bacterial wilt and good demand for turmeric. The objective of the trial therefore is to select high yielding turmeric genotype with good quality for release in Ethiopia, To select best perform variety with wider adaptability, quality and high yielder and To test the stability of the genotypes at contrasting environment

2. MATERIAL AND METHODS

Eight turmeric genotypes including the released variety "DAME" from the germplasm held at Tepi National Spices Research Center, Ethiopia, were evaluated during the season of 2014-2016 on station (TNSRC) laid out in randomized complete block design (RCBD). From them three best genotypes (HT3/2002, HT2/2002, and BONGA 51/71) with high yield and quality were selected and promoted to national variety trial. The national variety trial were planted at six locations Tepi (7° 3' N and 35° 18' E), Bebeka (7°0′N 35°35′E), Metu (8°18′N 35°35′E), Jimma (7°40′N 36°50′E), Areka (7°4′N 37°42′E) and Welkite (8°17′N 37°47′E), representing different agro-ecologies in Ethiopia. The treatment comprises three genotypes together with Dame the released variety of turmeric and laid out in RCBD using three replications. The plot size was 12 m^2 using raised beds and three to five cm long mother rhizomes having at least one active bud were drilled manually into the row at the rate of 25 qt/ha without application of fertilizers seeding rate of 1 rhizome/stand. The plants were spaced 30 cm X 15 cm apart between rows and plants, respectively. The experiment was kept weed free by the application of hand weeding. The plants were harvested when leaves had dried. Data were collected on the following growth and harvest parameters: plant height, number of tiller per plant, number of leaves per tiller, leaf length, leaf width, rhizome length, rhizome width, and finally rhizome yield per plot were measured. Across and combined analysis of variance will be carried out using SAS 9.2 version software.

Table1. *Pedigree of Turmeric accessions evaluated*

No.	Accessions cod.	Origin (woreda)
1	HT3/2002	Ethiopia
2	51/71 Bonga	Ethiopia
3	PAK6/82	Pakistan
4	KT14/2004	Ethiopia
5	HT2/2002(B)	Ethiopia
6	DAME	India
7	SODO07/2004	Ethiopia
8	HT1/2002(A)	Ethiopia

3. RESULTS AND DISCUSSION

Turmeric accessions evaluation study and result discussed in detail. Both the preliminary variety trial and national variety trial result were presented and discussed below.

3.1. Preliminary Variety Trial

The preliminary variety trial of turmeric where conducted using eight accessions which are collected from the country and some are introduced from potential producing countries, accordingly the accessions evaluated for two consecutive years and give the result below.

Table2. *Mean of yield data of turmeric during of preliminary variety trial*

Year	2014	2015	Plant ht (cm)	Leaf width (cm)	Leaf length (cm)	Tillering ability	Rhizome length (cm)	Rhizome width(cm)
Genotypes	Tepi	Tepi						
HT3/2002	752.67^{A}	700.00^{A}	113.67^{A}	17.00^{A}	54.933^{A}	4.6^{AB}	4.5400	3.533^{A}
Bonga 51/71	666.67^{BA}	700.00^{A}	94.2^{B}	13.867^{B}	46.467^{CD}	4.5^{AB}	3.89	2.660^{B}
PAK6/82	625.00^{BA}	625.00^{A}	102.133^{AB}	15.23^{AB}	47.467^{BCD}	4.1^{AB}	4.25	2.880^{B}
KT14/2004	602.67^{BAC}	533.33^{A}	91.533^{B}	14.200^{B}	43.467^{D}	3.73^{AB}	4.5867	3.113^{AB}
HT2/2002	600.00^{BAC}	586.00^{A}	93.8^{B}	13.333^{B}	44.133^{CD}	3.4^{B}	3.947	2.820^{B}
DAME	580.67^{BAC}	583.33^{A}	98.8^{B}	14.533B	47.400^{BCD}	3.73^{AB}	4.18	2.947^{B}
SODO07/2004	486.00^{BC}	644.33^{A}	112.00^{A}	17.0667A	52.267^{AB}	5^{A}	4.093	3.067^{AB}
HT1/2002	391.67^{C}	333.33^{B}	95.533^{B}	13.867B	49.467^{B}	4.1^{AB}	4.48	2.953^{B}
Mean	588.169	588.165	100.21	14.887	48.200	4.133	4.246	2.997
							Ns.	
LSD	214.43	192.69	11.74	2.29	5.3499	0.377	0.875	0.526
CV (%)	20.8	20.8	4.82	6.314	4.567	7.693	8.476	7.219

There were a significant difference between treatment response , accessions where found response similarly over year and location so, since turmeric is a vegetative propagated crop, genetic stability is not the major issue, and the crop can perform well in all the tested location. The evaluated accessions shows as significantly different interims of yield and quality, accordingly, the top three accessions which is superior in yield and quality to that of Dame the released variety were selected for further evaluation in the national variety trial.

3.2. Result of National Variety Trial

From the result of the national variety trial, the genotypes were found different in response to yield and yield related parameters

Table3. *Combined analysis for vegetative parameters over location*

Genotype	Parameter							
	Plant height (cm)	Leaf width (cm)	Leaf length (cm)	Tiller per plant	Rl	Rw	Nsf	Npf
HT3/2002	113.67^{A}	17.00^{A}	54.933^{A}	4.6^{AB}	29.05	18.09^{A}	20.71	8.15
HT2/2002(B)	93.8^{B}	13.333^{B}	44.133^{CD}	3.4^{B}	27.10	16.46^{B}	22.21	9.5
Bonga 51/71	94.2^{B}	13.867^{B}	46.467^{CD}	4.5^{AB}	29.01	17.51^{AB}	21.15	9.08
Dame	98.8^{B}	14.533^{B}	47.400^{BCD}	3.73^{AB}	28.85	16.61^{B}	20.83	8.51
CV	4.82	6.314	4.567	7.693	14.5	12.3	25	28.5

Whereas Rl: rhizome length, Rw: rhizome width, Nsf, number of secondary finger, Npf: number of primary finger , Ypp: Yield per plot, Yph: yield per hectare

Plant height varied significantly with turmeric genotype from 113.67 cm in HT3/2002 to 93.8 cm in HT2/ 2002 (Table 3) respectively. The reduced height may be explained in terms of low temperature indicating the susceptibility or lack of adaptability of turmeric to low temperature like Wolkite area. In terms of leaf production, most of the turmeric genotypes evaluated did not differ significantly in number of leaves produced per plant (Table 3). The effect of genotype and location on tillering in turmeric is presented in Table 3. Mean number of tillers/plant ranged from 4.6 in HT3/2002 to 3.4 in HT2/2002.

Table4. *Mean result of oleoresin content at different location*

Genotype	Location		
	Areka	Bebeka	Tepi
HT3/2002	7.53	6	7.3
HT2/2002	7.63	6.8	7.68
Bonga 51/71	6.73	5.77	7.5
Dame	6.4	6.36	7.06

This table showed that these genotypes have oleoresin content which is comparable with the required standards. These three genotype showed higher oleoresin content than the standard check Dame variety.

Table5. *Response of turmeric lines for contrasting environment for yield*

Year	2013	2014	2015						
Genotypes	Tepi	Tepi	Tepi	Bebeka	Jimma	Metu	Areka	Welkite university	Combined
HT3/2002	752.67^{A}	700.00^{A}	685.19^{A}	978.8	331.73^{A}	425.93	136.77^{B}	248.27	467.79^{A}
HT2/2002	600.00^{BAC}	586.00^{A}	357.14^{B}	952.4	217.46^{B}	401.59	166.14^{A}	141.43	372.69^{C}
Bonga 51/71	666.67^{BA}	700.00^{A}	489.42A^{B}	1105.8	256.61^{B}	426.85	154.23^{AB}	215.57	441.42^{AB}
Dame	580.67^{BAC}	583.33^{A}	399.47^{B}	1089.9	245.24^{B}	381.61	130.42^{B}	123.76	395.07^{BC}
Mean	588.169	588.165	482.80	1031.74	262.76	408.99	146.89	182.25	419.243
LSD	214.43	192.69	219.7	NS	46.37	NS	28.51	NS	56.16
CV (%)	20.8	20.8	22.77	14.14	8.83	15.59	9.71	34.31	19.96

Table 5 showed that The genotype were respond uniformly over different agro-ecology and environment and no rank change, HT3/2002 accessions were found superior during the preliminary and national variety trial so it pass to variety verification trial. Table 5 showed that the genotypes responded differently for different parameters. For yield traits genotype HT3/2002 and Bonga 51/71 showed more than a 10% increment than the check (Dame) released variety.so this two genotypes have been recommended to be verified and official release.

Rhizome yield (quintal per hectare) varied significantly with both genotype and location (Table 5). Genotypes HT3/2002 and Bonga 51/71 gave the highest yield across location and combined analysis, respectively, while HT2/2002 gave the lowest yield across locations. Sisikumar *et al*., (1996) reported significant variation in fresh rhizome yield of entries in a turmeric multi-location trial in India. Other authors Nayak *et al*., 2006 and Rao *et al*., 2004) have also reported significant variation in rhizome yield among turmeric cultivars in terms of location performance. The yield in Wolkite University for most of the varieties was very poor probably due to low temperature within the growing season as explained earlier. Chaudhary *et al*., (2006) had suggested that the variation in rhizome characters, fresh yield and recovery percentage among various turmeric varieties could be due to genetic factors rather than the environmental conditions as reported by Subharayadu *et al*.(1976), however, this result tends to confirm the report of Subharayadu *et al*. (1976). Genotype by location interaction was not significant for most attributes including rhizome yield of turmeric. This is probably due to the fact that the genotypes responded in the same manner across the locations

Table6. *Characteristics of turmeric candidate and released varieties*

Varieties/candidates	Oleoresin %	Yield Kg/Ha	Dry recovery%	Days to maturity	% yield advantage over check
HT3/2002	7.01	467.79	15.4	330	18.4
Bonga 51/71	7.4	441.42	24.7	275	11.7
Dame	7.15	395.07	21.65	270	

4. CONCLUSION AND RECOMMENDATION

Having only one variety nowadays is very dangerous as the outbreak of disease and challenging environment become a treat for our varieties. Always it is advantageous to have more than one variety so

that we can at least get a choice if this treats happen because of their different genetic makeup. And also currently there is a high demand of turmeric from different stake holders as its importance in local and international market is increasing and it has been long time since the current variety registered.so for satisfying the increasing demands as this varieties have better yield advantage and to have a very recent variety it is important to have additional variety.

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