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Registration of Plant Varieties

Registration of two Sorghum Hybrids, ESH-1 and ESH-2

Sorghum (*Sorghum bicolor* (L) Moench) is an indigenous crop to Ethiopia and staple for many millions of people in most parts of Africa. The crop is one of the most important cereals grown in arid and semi arid areas where others often fail to survive. In Eastern Africa, more than 70% of sorghum is cultivated in the dry and hot lowlands where severe drought, low soil fertility, and poor stand establishment are the major hurdles for crop production (Mukuru, 1993). In Ethiopia, sorghum occupies 1.62 million ha annually and contributes 2.8 million MT to annual grain production in the country with increasing trend (CSA, 2008). The productivity of sorghum in Ethiopia is about 1.7 t ha^{-1}, which is significantly lower than experimental plots yield as well as yields obtained in areas where improved production technology packages were promoted. Significant achievements were registered in the development of early maturing and drought tolerant open pollinated varieties; however, there exists enormous yield advantage of hybrids over varieties.

Breakthrough in sorghum hybrid development began following the discovery of cytoplasmic male sterility (Stephens and Holland, 1954). Since then many countries have been engaged in hybrid variety development with significant success both in development and promotion of hybrid cultivars. In Ethiopia, research on sorghum hybrid development started in the late 1970s. In more recent years, hybrid parental lines from Purdue University and ICRISAT were introduced and tested for their Ethiopian adaptability and performance in hybrid combinations. In addition, adapted Ethiopian sorghum varieties were converted into hybrid seed parents through backcrossing.

Two male sterile genotypes namely, P 9501A introduced from Purdue and ICSA 21 introduced from ICRISAT expressed stable sterility at Melkassa and Melka Werer Research Centers. Suitable pollen parents or restorers (R lines) that completely restore fertility of the male sterile parent and synchronize in terms of days to flowering and had similar plant height as the seed parent were identified. Among the R lines tested ICSR 14 and ICSR 50 were found to be the best and their hybrids were stable over locations and years. The two hybrids (ESH-1 and ESH-2), 15 other genotypes, and the standard variety Teshale were evaluated in Randomized Complete Block Design in three locations (Melkassa, Mieso, and Kobo) during 2001 to 2005 to evaluate yield performance and stability across locations and years. Each year, hybrid seed was produced in off-season nursery at Melka Weree for multi-location evaluation yield testing. Simultaneously, the selected parental lines were tested for their seed production ability and synchronization in terms of days to flowering and plant height matching the respective restorer lines which is essential for successful seed production.

Characteristics of hybrid parents

P 9501 A - White seeded sorghum grain, in average 58 days required to flowering, plant height 160 cm, deep green leaf contributes for the hybrid to resist drought.

ICSA 21 - White seeded sorghum grain, in average 67 days required to flowering, plant height 150 cm.

ICSR 14 - White seeded sorghum grain, in average 59 days required to flowering, plant height 150 cm, bold seeded and high grain yield performance which allows seed growers to use it as a variety as well.

ICSR 50 - White seeded sorghum grain, in average 59 days required to flowering, plant height 134 cm.

Characteristics of hybrids

P 9501A x ICSR 14 is released as Ethiopian Sorghum Hybrid-1 (ESH-1). ESH-1 is a white seeded drought tolerant hybrid with 30 % grain yield advantage over the standard check variety Teshale. The number of days to flowering ranged from 71-88 with a mean of 76 days after planting. The hybrid matures from 115 to 120 days with semi-compact and erect panicle appearance. ESH-1 is shorter in height (160-243 cm) compared to the local varities and the standard check, however, it has better biomass production and good quality grain. ESH-1 has thousand seed weight of 29 gm. The mean grain yield performance under research field conditions ranged between 5.0 and 5.5 t/ha with a mean of 5.3 t/ha and on farmers' fields the yield ranged from 3.5 to 4.5 t/ha. The hybrid comes with a low tannin parental background and has excellent grain quality (white grain) that produces good quality food product. Enjera (leavened bread) making quality test showed that it has good general acceptance with the color of creamy white and good elasticity. ESH-1 is preferred due to its drought tolerance and stability in wider environments than ESH-2.

ICSA 21 x ICSR 50 is released as Ethiopian Sorghum Hybrid-2 (ESH-2). ESH-2 gave 29 % yield advantage over the check and gave better performance in areas where moisture is a limiting factor. Grain yield performance on research stations ranged from 4.2 - 6.0 t/ha with a mean of 5.2 t/ha and on farmers' fields the grain yields ranged from 3.5 to 4.3 t/ha. Plant height ranged between 150 and 192 cm with the mean of 167 cm. The number of days to flowering was similar with the standard check Teshale. The hybrid is relatively shorter in height than the local varieties which farmers prefer to use for different purposes, however, ESH-2 has better biomass production. In terms of utilization, it has good general acceptance for enjera with light brown color and dry texture. The hybrid flowers within the range of 61 to 75 days with a mean of 72 days. This hybrid is ready for harvesting between 120 and 230 days after planting. It has semi-compact and erect panicle appearance with thousand seed weight of 30 gm.

Taye Tadesse[1], Tesfaye Tesso[2] and Erenso Degu[3]
[1,3] Ethiopian Institute of Agricultural Research, Melkassa Research Center,
P. O. Box 436, Nazareth, Ethiopia, Email: taytad032003@yahoo.com; [3]now at Kansas State University, Department of Agronomy, Email: ttesso@ksu.edu

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Black Pepper (*Piper nigrum* L.) 'Tato' and 'Gacheb'

Black pepper (*Piper nigrum* L.), commonly known as the "king" of spices, is a member of the family *Piperaceae* that originated in the sub-mountainous tracts of Western Ghats in India. The crop is best adapted to the humid tropics that require adequate rainfall and humidity and grows successfully between 20^0 N and S latitude and from zero up to 1500 m altitude above sea level. A well-distributed annual rainfall of 1500 to 2500 mm is considered ideal for the growth of black pepper. The crop tolerates temperatures between 25^0C and 35^0C (Purseglove, *et al*. 1981). In South Western Ethiopia, forest soils that are either red or chocolate in color classified as Dystric Nitisol with loam texture is very suitable for black pepper . In general, hot humid lowland coffee growing areas of South Western Ethiopia is very ideal for black pepper production.

Black pepper in the form of black or white is the fourth most traded spice in the world. India, Indonesia, and Brazil are the major producers and exporters globally and productivity ranges from 2.8 for India to 6.7 tons per hectare for Cambodia. In Ethiopia, the production of black pepper is only about 150 metric tons per annum from an area of approximately 300 hectares. Its productivity in research plots is in excess of 2.0 t/ha dry berries but in farmers' field the average yield is about 1.0 t/ha.

A total of fourteen accessions were introduced during 1979 and 1980 from India, though they might have been originally obtained from Brazil, Sri Lanka or Madagascar. Since then, accessions have been tested for their adaptation and yield performance at Tepi Agricultural Research Sub-Center and in collaboration with Coffee Plantation and Development Enterprise at Bebeka, Baya, Kabo and Komi farms. Testing of the accessions for their adaptation, yield, disease, pest and stress tolerance and quality, resulted in the identification of two high yielding genotypes namely Sr.3/80 and Pan 4/80. The mean dry fruit yield was 2.3 t /ha for Sr.3/80 and 3.0 tones /ha for Pan 4/80. These varieties have uniform and vigorous stand, large

leaves, long spike, high number of rows per spike, big pepper corn, and high oleoresin and essential oil content. Oleoresin % (w/w) and essential oil % (v/w) content of Sr.3/80 was 10 and 2.3, respectively, and variety Pan 4/80 gave oleoresin % (w/w) and essential oil % (v/w) 9.1 and 3.2, respectively. On average, both varieties gave a piperine content of 6%. The international standard of oleoresin % (w/w) and essential oil % (v/w) is 6.5-10 and 1-3, respectively (Purseglove, *et al*., 1981). These genotypes were released as Tato (Sr.3/80) and Gacheb (Pan 4/80) during 2007 by Ministry of Agriculture and Rural Development, Animal and Plant health Inspection Directorate. These are maintained at Tepi National Spices Research Center of the Ethiopian Institute of Agricultural Research.

Girma Haile Michael and Degafe Tilahun: Tepi National Spices Research Center, Wondifraw Teferra and Amsalu Nebiyu: Jimma Agricultural Research Centre and Edossa Etissa: Melkassa Agricultural Research Centre.

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Ginger (*Zingibere officinale* Rosc.) Varieties 'Yali' and 'Boziab'

Ginger is believed to have been introduced into Ethiopia in the 13th century by Arab traders from India. Since then it had been widely cultivated and utilized in the country under varied environments than any other spice. The crop thrives best in areas with altitudes from sea level to 1500 masl, mean temperature of 20° to 32°C and with a total annual rainfall greater than 1200 mm. The ideal soil type for the production of ginger is a well-drained, fertile and friable soil, with a neutral pH. In Ethiopia, the total area coverage of ginger production during 2004 to 2007 was 45,164 hectares with 716, 550 tones of rhizome yield (MoARD,2007). The crop is mainly grown in the wetter regions of Kaffa, Illubabor, Gamo Gofa, Sidama and Wellega areas, mostly in gardens and around homesteads. Large-scale production and marketing of ginger are also reported from Gore (Illubabor), Wolaita, Kembata-Tembaro, etc. There is also significant quantity of production in the North-Western parts of the country like Chilga and Awi Zone in the Amhara Region for home/domestic consumption and export to Sudan. Ethiopia has significant benefit from export of dried ginger.

It is believed that there is substantial level of genetic variability in yield, disease and pest tolerance, and quality within local ginger germplasm. Hence, 48 local and introduced accessions of ginger were evaluated in ginger observation nursery during 1994 to 97. Then, ten accessions were evaluated further during 1998 to 2004 at Tepi,

Bebeka, Jimma, and Metu. Of the ten genotypes, three accessions namelyMiz.180/73 collected from Mizan Teferi in Bench-Maji Zone, Maw.37/79 and Mar.38/79 introduced from Australia in 1979 were critically verified for yield, disease and pest reaction/tolerance and for their wider adaptability during 2005 to 06 . In the end, Miz.180/73 (Yali) that yielded 2.41 and Maw.37/79 (Boziab) that gave 2.14 t / ha of fresh rhizome as compared to 1.40 t /ha of the national average yield were released. Oleoresin content % (w/w) of the new varieties Yali and Boziab was 6.5 and 9.2, respectively while their essential oil % (v/w) content was 1.3. The international market standard of oleoresin % (w/w) is 3.5 to 10 % and essential oil % (v/w) is 1 to 3% for dried ginger (Girma and Kindie 2007). Special qualities of the varieties are: light yellow color of the rhizome, big size of rhizomes, high essential oil and oleoresin content, vigorous germination and field establishment, and high stand uniformity. These varieties were released by the Ministry of Agriculture and Rural Development, Animal and Plant Health Inspection Directorate and are being maintained, multiplied, and distributed to users in different potential growing areas of the country by Tepi National Spice Research Center.

Girma Haile Michael and Degafe Tilahun :Tepi National Spices Research Center, Wondifraw Teferra and Amsalu Nebiyu; Jimma Agriculture Research Centre and Edossa Etissa Jimma Agricultural Research Centre.

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Registration of Cardamom (*Elettaria cardamomum* L. Maton) Variety 'Gene'

Cardamom (*Elettaria cardamomum* L. Maton) that belongs to the family of *Zingiberaceae,* is one of the very expensive spices globally (Purseglove *et al*., 1981) as well as nationally in Ethiopia (Edossa, 1998). It is used in food and beverages seasoning in the form of whole capsules or powder after seed decortications. It also has a high role in pharmaceutical and perfumery industries as a result of its strong aromatic nature. The oleoresin and volatile oils are important products of cardamom after extraction.

Cardamom grows well within altitude range of 700 to 1400 masl and average temperature of 25° to 32°C. It is a shade obligate crop and provision of a permanent shade all along its growth is compulsory (Pureseglove, *et al*., 1981). Coffee shade trees (*Erythrina*, *Milletia*, *Albizzia*, and *Gravellia* species) are suitable shade trees for cardamom in Ethiopian condition (Edossa, 1998). The crop requires an annual rainfall higher than 1500 mm and cannot tolerate a dry spell for more than few weeks, thus provision of supplementary irrigation in areas of moisture deficit is important. Humus rich soils holding a good growth of evergreen forest are ideal for cardamom provided there is a well applied mulch and adequate moisture. High steep slopes and exposed areas are not suitable for good cardamom field establishment and production. This plant abhors disturbance of soils around the plantation as its roots are shallow and superficial. In Ethiopia, coffee growing areas especially where *korarima* grows are suitable for cardamom plantation. Since the ecological conditions of the area around Tepi and Bebeka are so conducive for the crop, the coffee state farms at both locations had been producing cardamom for over a decade.

Two types of cardamom were introduced to Ethiopia; one was with the erect panicle (the Mysore type), coded Tan. 82/72 introduced in 1972 originally from Tanzania and the second was with the prostrate panicle (the Malabar type), coded Ind. 14/79 introduced in 1979, originally of Indonesian origin. Since the 1980s untill 2005 (after establishment), both accessions were tested for their adaptation, vegetative growth, disease and pest tolerance and yield performance at Jimma and its sub-centers at Tepi, Metu, Wonago, Bebeka, Baya, Kabo, Shosha, and Komi state farms in collaboration with the Coffee Plantation Development Enterprise . Oleoresin and essential oil content of the accessions had been evaluated by the Essential Oil Research Laboratory, Ethiopian Spices Extraction Factory, and Addis Ababa University Chemistry Department. Multi location testing for various years proved that Mysore type (Tan.82/72) resulted in higher capsule yield with better quality. Thus, following intensive evaluation, accession Tan.82/72 named as 'Gene' was released by the Ministry of Agriculture and Rural Development, Animal and Plant Health Inspection Directorate in 2007. This variety has coarse leaves that are glabrous from beneath, upright (arching) panicle orientation and relatively long and big fruits which are three angled and ribbed unlike the second type that has a prostrate panicle orientation and small rounded fruits. 'Gene' also has robust pseudostems, long panicle and more capsules per panicle which is very positively correlated with final yield. In addition, it has good resistance to diseases and pests, and competes well with weeds. 'Gene'

yields 0.18 to 0.2 tones dry capsule per hectare. 'Gene' contains oleoresin % (w/w) and essential oil content % (v/w) of 6.2 and 6.1, respectively (Girma *et al*., 2008). The essential oil content % (v/w) of the International standard is 3.5-7 % indicating that Gene fulfils the requirement of the World Market (Edossa *et al*. 1998).

Recommended propagation of cardamom in general or 'Gene' in particular is by means of seedling raised from seed and starts yielding in about four years. Planting materials of 'Gene' is being maintained by Tepi National Spices Research Center. Significant number of 'Gene' seedlings are being multiplied and distributed to farmers. 'Gene' is being cultivated by farmers, private investors, and Coffee Plantation Enterprise Farms at Kabo.

Girma Haile Michael and Degafe Tilahun; Tepi National Spices Research Center, Amsalu Nebiyu and Wondifraw Teferra; Jimma Agricultural Research Centre and Edossa Etissa; Melkassa Agricultural Research Centre.

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Registration of Turmeric (*Curcuma domestica*) Variety 'Dame'

Turmeric (*Curcuma domestica*) is a very important spice crop in the world. The crop adapts well to hot and moist climate and grows well in altitudes from sea level to 2000 masl with annual rainfall of 1000-2000 mm, mean temperature of 20° to 32°C (Purseglove *et al*., 1981). In Ethiopia, turmeric is usually grown at similar agro-ecologies with ginger commonly in the wetter regions of Kaffa, Illubabor, Gamo Gofa, Sidama and Wellega areas, mostly in gardens and around homesteads (Edossa, 1998). In 2004-2007 turmeric occupied 3064 hectares with production of 67,998 tones almost all coming from Kaffa (MoARD 2007). In the same period, the national average yield was 17 t/ha. Turmeric is used for coloring in food, pharmaceuticals and cosmetic industries. Ethiopia is self sufficient in turmeric production.

Two accessions of turmeric (*C. domestica*) were introduced to Ethiopia four decades ago. The first Ind. 48/72 was introduced from India in 1972 and the second Pak. 6/82 was introduced from Pakistan in 1982. Since then, both accessions were under

intensive evaluation for their adaptation, yield, reaction to diseases and pests and quality. The essential oil, oleoresin and curcumin contents were assessed by the former Essential Oil Research Centre, KASSK (private laboratory), Ethiopian Spice Extraction Factory and Chemistry Department of Addis Ababa University. Field and laboratory data indicated that, accession Ind.48/72 resulted in high fresh rhizome yield containing higher oleoresin, essential oils and curcumin, hence it was proposed for registration as Dame. Dame has very uniform stand, high vigor, and large leaves and establishes fast after germination. Dame gives fresh rhizome yield of 25 to 30 t/ha. It has oleoresin content % (w/w) and essential oil content % (v/w) 18.1 and 5.1, respectively (Berhanu and Nigist, 1987). The important component of turmeric is its curcumin content, the coloring power of the spice. This is due to the pigment called curcuminoid and variety Dame has 25% curcumin content. The color is deep-yellow-orange when the rhizome/product is processed. Dame is being maintained, multiplied, and distributed to farmers by Tepi National Spice Research Center.

Girma Haile Michael and Degafe Tilahun: Tepi National Spices Research Center, Wondifraw Teferra and Amsalu Nebiyu: Jimma Agricultural Research Centre and Edossa Etissa Melkassa Agricultural Research Centre

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Black Cumin (*Nigella sativa* L.) Varieties 'Aden' and Dershaye'

Black cumin (*Nigella sativa* L.) is a spice that grows as a rain fed crop within 1500 to 2400 meters of altitude on heavy black soils. Black cumin has a similar ecological requirement as teff and chick pea. It is a major crop in Dembia, South Gonder, Shirka in Arsi Zone and Goro in Bale Zone. In Dembia, black cumin is cultivated using residual moisture following the main rainy season. Black cumin is exported mostly to Middle Eastern countries as seed or oleoresin where it is used as a spice and medicine. Oleoresin is produced using solvent extraction followed by desolventising.

Eden was introduced from Yemen Arab Republic while Dershaye was obtained from the Institute of Biodiversity Conservation with passport number of 223072. In 2004 black cumin preliminary observation nursery was initiated at Wondo Genet by the

oilseeds and spices team. The observation included 42 accessions obtained from the Institute of Biodiversity Conservation. The 42 accessions and two introduced lines were characterized for agronomic and quality traits. During the off-season of 2005/06, promising accessions were mass selected for high seed yield and quality. During the main season of 2005/06 yield testing was carried out at Adet and Woreta in the Amhara Region. In 2006/07 yield testing was carried out at Jimma, Bonga, Kulumsa and Adet. In 2008/09 a test was carried out in three zones of major black cumin growing areas including local and standard checks.

Two candidates, a local and standard (Derbera) checks were planted at three farmers' fields in Denbia Woreda of North Gonder, two sites in Sherka in Arsi Zone; two sites in Goro in Bale zone and at Kulumsa Research Center in 2008/09 cropping season. Data such as days to flowering, days to maturity, plant height, seed yield, and oleoresin and essential oil contents were recorded. Essential oil content was determined using hydro-distillation while oleoresin content was determined using soxtec extraction. All eight test locations were evaluated by a technical committee appointed by the national variety release committee. In the end, the two candidates were released as Dershaye and Eden.

Both Dershaye and Eden gave seed yield of up to 1.5 t/ha at Kulumsa Research Center. However, seed yields were lower on farmers' fields in Dembia, Shirka and Goro. Dershaye yields were about 0.8 to 1.2 t/ha while Eden gave 0.8 to 1.1 t/ha on farmers' field.

Eden takes 66 to 72 days from planting to flowering while Dershaye requires 69 to 82 days to flower. Both Dershaye and Eden require 134 to 150 days from planting to full maturity. Both varieties reach a height of 54-64 cm at maturity. Although, both varieties have equal number of primary branches per plant (2-4), Dershaye has more secondary branches per plant that bear more pods and hence higher seed yield. The two varieties have higher seed yield, oleoresin and essential oil contents in the seed. Black cumin is low volume and high value crop and can be a good rotation crop for cereals and pulses. In Denbia, it is a rotation crop for chick pea and teff. Both chick pea and black cumin are cultivated using residual moisture.

Eden has fatty oil of 37 to 41 %, essential oil of 0.6-1.2% and oleoresin of 27.2 to 32.4%. Dershaye has fatty oil of 36 to 41 %, essential oil of 0.7-1.3 % and oleoresin of 30.8 %. The fatty oil from black cumin is not used for cooking due to its nigellon content that causes bitter taste of the oil. Dershaye and Aden were developed by the former Essential Oils Research Center and registered by the Ministry of Agriculture and Rural development, Animal and Plant Health Regulatory Directorate in 2009.

Getinet Alemaw[1], Adam Abebe[2], Daniel Bisrat[3] , Asmamaw Yeshanew[4] , Dereje Regassa [5]and Fekadu G/Tensay[6]
Ethiopian Institute of Agricultural Research, [1]Melkassa Agriculture Research Centre [3] Addis Abeba University and [6]Kulumsa Agricultural Research Center; Amhara

Agriculture Research Institute, [2]Adet and [4] Gonder Agriculture Research Centers and [5]Oromiya Agriculture Research Institute, Sinana Agriculture Research Center.

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Mango (*Mangifera indica* L.) Variety Apple' Mango

Edible cultivars of mango can grow well from sea level to an altitude of about 1500 m in many countries of tropical and subtropical regions of the world with higher temperature that hastens maturity and improves fruit size and quality (Crane and Campbell 1994). There are thousands of cultivars of mango that originated by chance from superior seedlings arising from natural crossing or gene mutation. Almost all of these cultivars are monoembryonic and do not come true to type from seed and therefore need to be propagated asexually. However, monoembryonic cultivars can be raised through seed only to obtain rootstock seedlings for subsequent grafting. On the other hand, the polyembryonic cultivars are much inferior in fruit size and quality, but are suited for developing genetically uniform clonal rootstocks. In Ethiopia, mango is grown in Gambella, Deddesa, Rift Valley, Harar, Shewa Robit and Arbaminch areas. Mango is a recently introduced tropical fruit crop that has significant contribution to the livelihood of small scale farmers and the national economy.

In 2008/9, mango covered 6,051hectares or12.61 % of the area allotted to fruit crops in Ethiopia and contributed 12.6 % of the production (44,158 tones) of the national peasant holdings (CSA 2009). During this period, the average national yield was 7.3 t/ha which is far below the world average and the potential yield. In addition, most of the mango trees in the peasant holdings are producing poor quality fruits (small fruited, large seeded and fibrous), with low yield potential. Hence, 'Apple' mango variety was tested at Melkassa and Nura Era locations and released for wider production in the major mango growing agro-ecologies of the country.

'Apple' mango, introduced from Kenya in 1972, was found to be the best adapted variety with different important features. It is maintained true to type by using vegetative propagation.

One of the best characters of 'Apple' mango is its seed polyembryony, where seed propagation does not bring any segregation unlike other commercial mango varieties. As in most mango cultivars, 'Apple' mango has also alternate bearing character. It has medium upright spreading tree growth habit. Fruits are round/oval in shape and with yellow orange flesh upon ripening. There were no serious diseases recorded. 'Apple' mango variety is cold sensitive.

Since there is no standard check variety for mango, trees of local checks were used to compare 'Apple' mango even though every local mango tree is expected to be genetically different from every other. The fruit yield of 'Apple' mango ranged from 20 to 40 t/ha with average of 32 t/ha. When this is compared to the local check (10 t/ha) and the national average (7.3 t/ha), yield advantages of 320 to 438 % can be assumed. 'Apple' mango has little or no fiber content, more flesh and with an average of 400 g fruit size with very small seed size. The fruit has thin skin, excellent flavor and attractive yellow orange flesh. The average weight of seed inside the fruit weights about 30 g and the total soluble solids and juice content were 20 brix and 290 ml per fruit, respectively. 'Apple' mango can be produced both for fresh consumption and processing purposes. Apple mango is maintained by and seedlings are available at Melkassa Agricultural Research Centre.

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Registration of Avocado (*Persea americana* Mill.) Varieties Hass, Fuerte, Pinkerton, Bacon, Ettinger, and Nabal.

Avocado is evergreen, medium to large sized fruit tree with large dark-green leaves. It is native to the American Tropics, and grows in a dense, symmetrical form with leaves and branches growing to the ground when young. Avocado can be grown in areas with altitudes up to 3000 m, but performs best from 1500-2000 m (Morton 1987). Avocado is a recent introduction tropical fruit crop to Ethiopia and yet it is contributing a significant role in changing the livelihood of farmers. Avocado fruit contains about 26% fat of the edible portion and has a reasonable quantity of vitamins and minerals. Avocado is one of the most marketable fruit crops that generate income for producers and traders. It has also great potential for export markets. As a result, the government has given top priority to expand the scale of fruits production including avocado and increase its productivity at the house hold level.

The production of avocado in 2008/9 main season was estimated 32,452 tons from 5,067 hectares and was only exceeded by banana and mango. In the same year, the national average yield was estimated at 6.4 t/ha which is far lower than both the global average and potential yield of avocado in Ethiopia. This is mainly because most

of the avocado trees in the peasant holdings are obtained from seedlings on the farm thus producing poor quality fruits and with low yieldpotential. Hence internationally reputable six avocado varieties namely Bacon, Ettinger, Fuerte, Hass, Nabal and Pinkerton were introduced from Israel by the then Horticultural Development Department in 1986 and tested at Jimma, Melkassa, Nura Era and Ziway locations (EIAR 2001). They were maintained true to type by using vegetative propagation.

Some of the main morphological and other traits of the varieties are described as follows:

Hass is semi-spreading, Fuerte and Pinkerton are spreadingwhile Bacon, Ettinger and Nabal are upright. In terms of fruit shape, Hass is short pear, Ettinger, Fuerte and Pinkerton are pear; Bacon and Nabal are nearly round. The fruit skin texture and color is leathery rough, dark-purple but black when ripe for Hass; leathery smooth, bright green for Pinkerton; slightly rough and green for Fuerte; slightly rough and bright green for Ettinger; smooth green for Bacon and fairly smooth and dark-green for Nabal. Pulp color is creamy pale green for Hass, Ettinger, Fuerte and Pinkerton, yellow-green for Bacon and nearly green skin for Nabal. Ettinger, Fuerte and Hass are early, Pinkerton is medium and Bacon and Nabal are late maturing. In terms of cold resistance, Hass, Nabal and Pinkerton are sensitive; Ettinger and Fuerte are moderate and Bacon is hardy. No disease was recorded at Melkassa, however, root rot was observed at Jima. There is no standard check variety for avocado in Ethiopia, hence no local checks were included in the trial because every local avocado tree is expected to be genetically different from every other as a result of cross-pollination. Therefore, the varieties were compared with each other. The average yield obtained for the varieties Ettinger, Fuerte, Bacon, Hass, Nabal and Pinkerton were 34.2, 25.7, 22.8, 22.3, 15.4 and 13.8 t/ha, respectively. When the average yields of these varieties is compared with the yield of the national average (6.4 t/ha), yield increments of 534, 401, 356,342, 240 and 215% for Ettinger, Fuerte, Bacon, Hass, Nabal and Pinkerton, respectively, can be assumed. Oil content was 16 % for Nabal, 20% for Pinkerton and 18% for others. Hass provides fruits with firm flesh, non-fibrous, superior taste, good flavor and excellent keeping quality. Similarly, Pinkerton has fruits with thick flesh, good flavor and good keeping quality. Fruits from Fuerte have buttery flesh and excellent flavor; Ettinger produces fruits with fibreless flesh; Nabal produces fruits with high quality flesh which can be stored relatively longer while fruits of Bacon have poor shelf life. These avocado varieties produced relatively bigger fruits than the local cultivars. On average, fruits ranged from about 200 g for Hass to more than 350 g for Nabal. Unlike the local trees, these varieties also produce fruits with small seeds, the smallest and the biggest being about 30 g and 60 g for Pinkerton and Bacon, respectively. Fruits of Hass, Ettinger, Fuerte and Pinkerton are found to be easy to peel while fruits of Bacon and Nabal have medium peeling characteristics. These avocado varieties were registered by the Ministry of Agriculture and Rural Development, Animal and Plant Health Directorate in 2008 and maintained at Melkassa Agriculture Research centre.

Edossa Etissa, Asmare Dagnew, Lemma Ayele and Wogayehu Assefa :-Melkassa Agricultural Research Center. Haileab Atsebeha and Wondyifraw Tefera:- Jimma Agricultural Research Center

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Registration of Dessert Banana (*Musa spp.*) Varieties

Bananas are grown in all tropical regions of the world and play a key role in the economy of many developing countries. In terms of gross value of production, bananas are the world's fourth most important food crop after rice, wheat and maize. As a staple, bananas, including plantains (cooking banana), contribute to the food security of millions of people in much of the developing world, and when traded in local markets, they provide income and employment to rural populations. Bananas are one of the cheapest foods to produce; their cost of production is less than other staples such as rice and can produce fruits year round. They are particularly suited to intercropping systems and mixed farming with livestock, and contribute to the conservation of natural resources. As an export commodity, bananas are key contributors to the economies of many low-income countries. They are the world's most exported fresh fruits in terms of volume and value.

Ethiopia is among the tropical countries suitable for banana cultivation with the opportunity of exporting fresh banana fruits to Middle East, Europe and neighbouring countries. Banana production in Ethiopia ranges from homestead to large commercial plantations. At present, bananas are the leading fruit crops produced in the country both in terms of area coverage and production where the bulk is produced in traditional agricultural system. In 2008/9 main season, banana covered 60.56% of the acreage or 29,064 hectare and contributed 55.3% production or 194,333 tones of the national peasant holdings of fruit crops. During this time, the average national yield recorded was 6.7 t/ha which is far below the world average and the potential yield. This is mainly because most of the banana plantations in the peasant holdings are poorly managed with low yielding varieties that bear poor quality fruits.

Over 40 clones of banana were introduced from the then INIBAP (now Bioversity-International) and Kenya during the 1980s as plantlets. These materials were tested for their performance and adaptation in the different agro-ecologies of Ethiopia. Among them, a total of 12 varieties for dessert were selected and tested at Melkassa, Jimma, Areka and Melka Werer Research Centers and registered for wider production owing

to their merit in yield and quality by the Ministry of Agriculture and Rural Development, Animal and Plant Health Regulatory Department in 2006. They are Grande Naine, Williams-1, Butuzua, Robusta, Dwarf Cavendish, Giant Cavendish, Poyo and Ducasse Hybrid. These varieties are maintained by vegetative propagation means.

Some of the main morphological and other traits of the varieties are described as follows.

Plant height: Ranged from 2.59 m to 4.60 m for all;
Leaf length: Varied from 0.86 m to 1.68 m for dessert;
Leaf width: Varied from 46 cm to 68 cm for dessert;
Consumption category: Eight of them are dessert (eaten raw);
Flesh color: Yellow upon ripening for all cultivars;
Fruit maturity: Ranged from 159 to 170 days;
Fruit shape: Thin, curved and long for desserts except Ducasse Hybrid which is thick;
Cold resistance: All varieties are cold sensitive;
Disease reaction: No serious diseases were recorded, except that Dwarf Cavendish is sensitive to nematode.

There was no standard check variety for banana in the country. However, the previously recommended varieties Dwarf Giant and Poyo were included in the trial for comparison. The average yield for Williams-1, Grande Naine, Robusta, Butuzua, Dwarf Cavendish, Poyo, Giant Cavendish and Ducasse Hybrid were 55.6, 43.6, 39.5, 39.1, 53.1, 48.2, 37.2 and 26.1 t/ha, respectively. When these are compared to the national average (6.7 t/ha), yield increments of 832, 653.7, 592.2, 586.5, 796.6, 722.7, 558.3, 390.7 % for Williams-1, Grande Naine, Robusta, Butuzua, Dwarf Cavendish, Poyo, Giant Cavendish and Ducasse Hybrid can be obtained in the respective order. Carbohydrate content is one of the most important quality traits for banana. The average fruit size varied from 109 – 143 g for dessert types, fruits of dessert bananas are bigger but have shorter keeping quality than the cooking types.

Seifu Gebre-Mariam, Asmare Dagnew, Dejene Abera, Abere Abate, Girma Kebede and Worku Beyene:- Melkassa Agricultural Research Center;
Haileab Atsebeha:- Jimma Agricultural Research Center;
Ali Mohammed,:- Jimma University;
Abiyot Aragaw and Leul Mengesha:- Werer Agricultural Research Center;
Yared Dagne, Leulseged Begashaw and Asfaw Kifle:- Areka Agricultural Research Center

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