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Sadao SAKAMOTO and Katsuyoshi FUKUI

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Sadao SAKAMOTO* and Katsuyoshi FUKUI**

INTRODUCTION

Modern agricultural techniques which bring about the modification of the traditional agricultural systems are widely prevailing all over the world. In this process, various native cultivated plants are replaced by newly introduced and improved varieties and thus many endemic forms disappear. Therefore, it is quite important to collect those endemic or primitive forms of cultivated plants for the conservation of gene resources for the ethnobotanical, genetical and plant breeding studies in future.

Ethiopia has been considered to be one of the most important world centers for the origin and differentiation of cultivated plants. After Vavilov (1926, 1928, 1951), the characteristics of this area were summarized as follows:

1. Concentration of endemic variations of cultivated emmer wheat and barley
2. The birth place of teff, sorghum, finger millet, niger seed, safflower, coffee, ensete banana, castor bean and chat
3. Abundance of variation in chick pea, lentil, field pea, grass pea, common bean, fenugreek, sesame and various spice plants

In 1967–1968 the Kyoto University organized a Scientific Expedition to the Sahara and the Surrounding Areas (K. U. S. E. S. 1967–68) with Professor K. Yamashita as the leader. The expedition party consisted of the Botany Team, the Agronomy Team, the Fine Arts Team, the Linguistics Team, the Medicine Team and the Anthropology Team. The members of the Botany Team were Kosuke Yamashita, Professor of the Biological Laboratory, Kyoto University, Sadao Sakamoto, Researcher of the National Institute of Genetics and Katsuyoshi Fukui, Graduate student of the Faculty of Agriculture, Kyoto University. The main activity of the Botany Team was focussed on the investigation of the variation patterns of various cultivated plants and the collection of their local strains in Ethiopia. The preliminary report of the activity of the Botany Team was published elsewhere (Yamashita *et al.* 1969). Studies on the vernacular names of cereals were reported by Fukui (1971).

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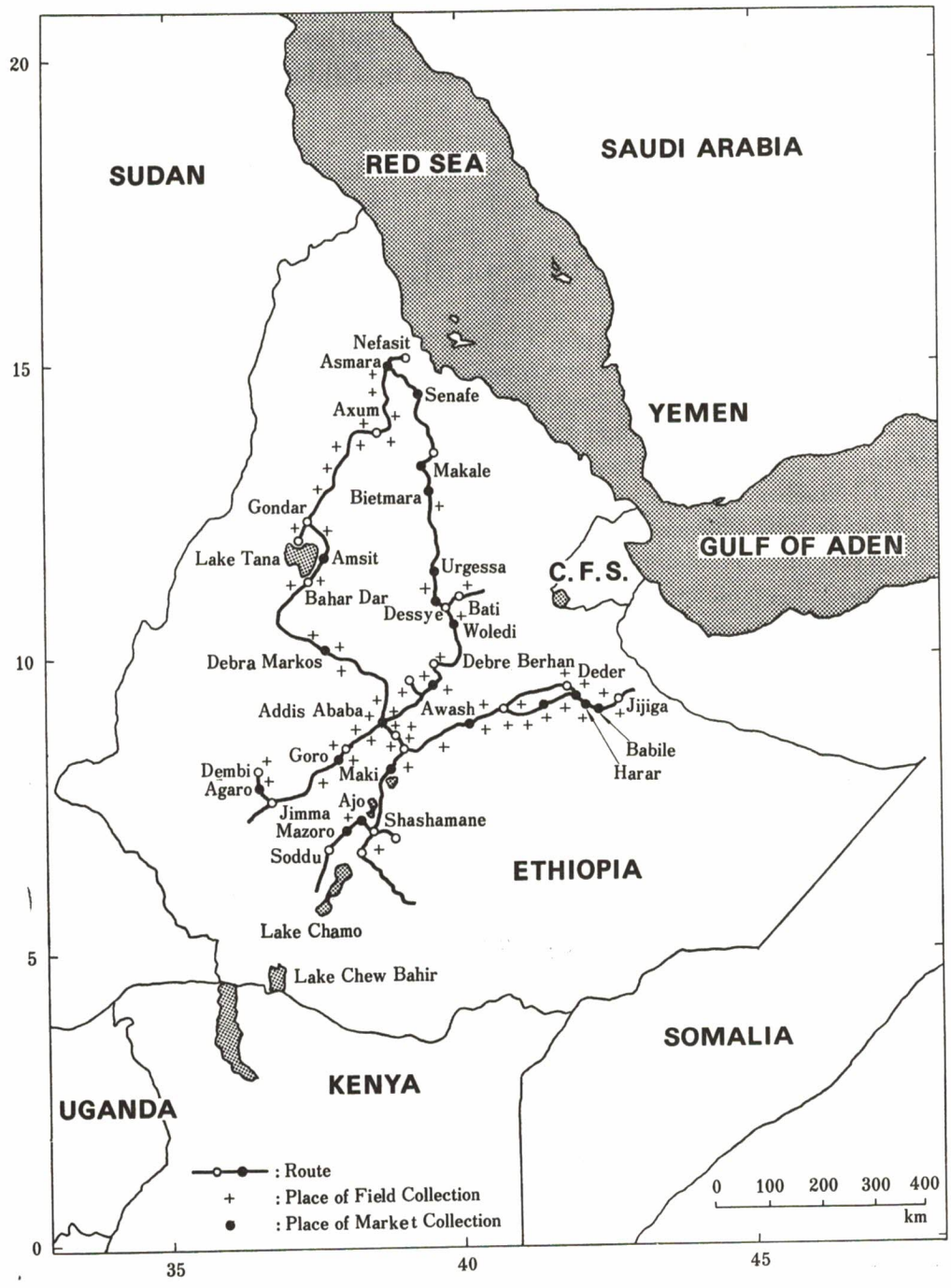


Fig. 1. Routes of the Botany Team of the Kyoto Univeristy Scientific Expedition to the Sahara and the Surrounding Areas, 1967-1968.

EXPEDITION ROUTES AND PERIOD

The Botany Team stayed in Ethiopia for three months from December, 1967 to March, 1968. The expedition was made along the main roads for the purpose of collecting field as well as market samples of various cultivated plants and wild plants. The brief itinerary of the Botany Team was as follows (Fig. 1):

Dec. 17, 1967–Jan. 8, 1968: Addis Ababa, Debre Zeit and the vicinity (1850–3200 m alt.) (Fig. 2)

Jan. 10–Jan. 18: Eastern part including Chercher Highland (880–2600 m alt.) (Fig. 3)

Jan. 23–Feb. 9: Central and Northern parts through Debre Marcos, Bahar Dar, Gondar, Axum, Asmara, Makale, Dessie and Debre Berhan (1400–3180 m alt.) (Fig. 4)

Feb. 19–Feb. 23: Southwestern part around Jimma (1000–2260 m alt.)

Feb. 26–Feb. 29: Southern part around Shashamane (1500–2000 m alt.) (Fig. 5)

METHODS OF COLLECTION AND OBSERVATION

Along the expedition routes various cultivated plants were observed and collected. Field collection was made from many localities as shown in Fig. 1. As many as possible of the various forms of cultivated plants and their weeds were collected from the cultivation fields (Figs. 7 and 8). In 12 wheat and 5 barley fields random sampling was made for the quantitative analysis of populations comprized from various forms and their weeds. For this purpose one or two bundles of wheat or barley were sampled from the field which seemed to be randomized due to culture practice of these two crops by local farmers. Market collection was made from 21 local markets along the routes as shown in Fig. 1. Seed samples were bought from local farmers at the market and at the same time their vernacular names were also recorded (Fig. 6).

Field collections are summarized in Table 1. Market collections including cultivated

Table 1. Field collections in Ethiopia

Species name	No. of samples	Species name	No. of samples	Species name	No. of samples
Triticum dicoccum	32	*Pisum sativum*	8	*Linum usitatissimum*	8
T. polonicum	1	*Cicer arietinum*	5	*Guizotia abyssinica*	4
T. durum + *turgidum*	388	*Lens esculenta*	1	*Carthamus tinctoria*	2
T. aestivum	79	*Vicia faba*	4	*Sesamum indicum*	-
Hordeum vulgare	208	*Lathyrus sativus*	1	*Ricinus communis* (wild)	2
Zea mays	19	*Phaseolus* spp.	3	*Lepidium sativum*	3
Sorghum bicolor	58	*Trigonella foenum-graecum*	1	*Brassica carinata*	10
wild *sorghum*	5	*Crotalaria* spp.	2	wild *Brassica*	7
Eragrostis abyssinica	36	wild Leguminosae	22	*Rhaphanus* sp.	2
Avena sp.	9	*Helianthus annuus*	1	*Capsicum frutescens*	2
Lolium temulentum	22	wild Compositae	4	others	59
Eleusine coracana	11			Total	1,057 samples
wild Gramineae	38				

Table 2. Market collections in Ethiopia

Name	No. of samples	Name	No. of samples	Name	No. of samples	Name	No. of samples
wheat	45	grass pea	7	red pepper	20	*Hagenia abyssinica* (koso)	20
barley	40	*Vigna* spp.	7	squash	10	*Rhamnus prinoides* (gesho)	6
		Phaseolus spp.	14				
corn	32	peanut	1	onion	13	*Nigella sativa* (tikur azumud)	20
sorghum	45	fenugreek	19	garlic	11	*Carum copticum* (nechi azumud)	20
teff	26	niger seed	10	tomato	2	*Embelia schimperi* (unkoko)	10
finger millet	8	safflower	5	potato	5	*Aframomum Korarima* (kororima)	10
field pea	31	sesame	11	ginger	11		
chick pea	24	castor bean	12	garden cress	15	other spices and drug plants	131
lentil	19	mustard	23	coffee	7	incense (etan)	9
horse bean	24	cotton	4			others	42
						Total	769 samples

plants and agricultural utensils are shown in Tables 2 and 3. About 1,500 herbarium specimens of wild plants were made during the expedition. The herbarium specimens were placed on file with the Department of Botany, Kyoto University.

Collection and preliminary observation of the following cultivated cereals and legumes are reported in the present article.

cereals: wheat, barley, teff, sorghum, finger millet and maize

legumes: field pea, chick pea, horse bean, lentil, *Vigna, Phaseolus* and grass pea

An appropriate random sample from each market collection was made and analyzed. The samples were classified mainly by shape, size and color of spikes and seeds. The 100 seed weight of each sample from the markets was measured. Seed fertility of legumes collected in the fields was examined. Moreover, the mixing rate of weeds or other cultivated plants found in a given sample of various cereals was also calculated.

RESULTS OF OBSERVATION

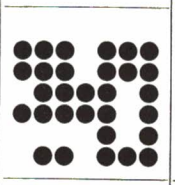
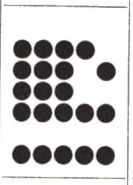
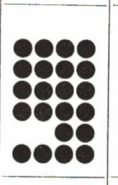
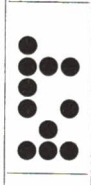
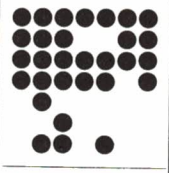
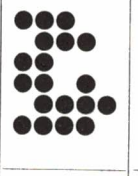
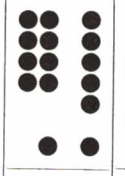
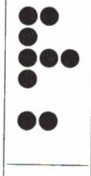
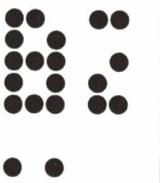
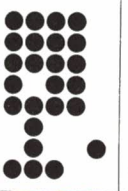
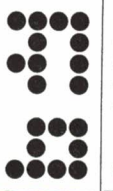
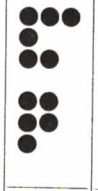
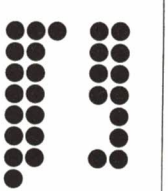
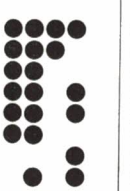
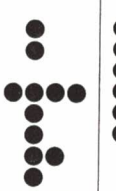
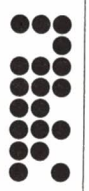
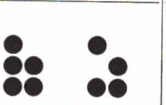
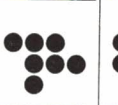
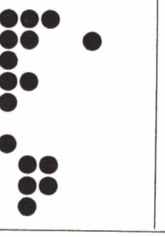
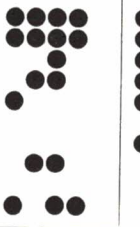
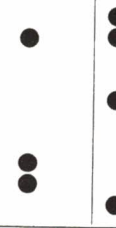
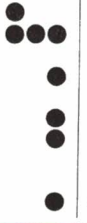
1. Wheat (*Triticum* spp.):

a. Field collections

500 samples of various forms of wheat were collected from the cultivation fields along the routes as summarized in Table 4. These samples were classified tentatively into five cultivated species, *Triticum dicoccum* Schübl., *T. durum* Desf., *T. turgidum* L., *T. polonicum* L. and *T. aestivum* L.

Among the present collections 32 samples of *T. dicoccum* were found in eight localities of the central and eastern parts of Ethiopia between 2200 m and 2800 m alt. from the sea level. The spike color of these samples was mostly yellowish but the spikes having yellowish glumes with black colored margin were also found. Only two samples of black

Table 3. Collection of various cultivated plants from 21 local markets of Ethiopia

Region	Central part	Easten part	Northern part	South-West-ern part	South-ern part
Place collected	Addis Ababa Debre Markos Amsit Urgessa Dessie Woledi Debre Berhan	Awash Station Babile Alemaya Harrar Deder	Asmara Senafe Makale Bietmara	Agaro Goro	Mazoro Ajo Maki
cereals: wheat barley teff sorghum finger millet maize					
legumes: field pea chick pea horse bean lentil *Vigna* *Phaseolus* grass pea					
oil seeds: fenugreek sesame flax niger seed rape seed mustard safflower castor bean					
spices: red pepper garlic ginger *Nigella sativa* *Carum copticum* *Aframomum korarima* *Coriandrum sativum* *Cuminum cyminum*					
crude drugs: *Hagenia abyssinica* *Lepidium sativum* *Embelia schimperi*					
incense: *Acacia senegal*					
others: pumpkin onion tomato potato sweet potato taro sugar cane *Rhamnus prinoides* cotton seed coffee					

spikes were collected in the field of Mt. Entoto near Addis Ababa at 2800 m alt.

Abundant variations of *T. durum* and *T. turgidum* were found in wheat fields which were growing those two species mixed together. Classification was often quite difficult due to continuous variations from typical *durum* type to *turgidum* type even in one field. Of 387 spikes collected, 287 were classified as *T. durum*, 95 as *T. turgidum* and the remaining 5 as intermediate forms between two species. Among them spikes with purple pigmented seeds which is endemic to Ethiopia, were observed in 61 samples (21.3%) of *T. durum* and 13 (13.7%) of *T. turgidum*. *T. durum* with black awns was collected from three localities, *i.e.* Mt. Erer which is located in the east of Debre Zeit (2400 m alt.), Shoa Province, 92 km from Addis Ababa to Fiche (2660 m alt.), Shoa Province, and ca. 10 km from Enda Selasse to Axum (1960 m alt.), Tigre Province. In a wheat field at 11 km from Ghion to Jimma, Shoa Province, spikes of *T. turgidum* having supernumerary spikelets were found together with normal *T. durum* and *T. turgidum*.

Only one sample of *T. polonicum* was collected in a field at 80 km from Addis Ababa to Ghion, Shoa Province. This sample was found from a *T. durum* field mixed with *T. turgidum*.

Among the dinkel wheats, only *T. aestivum* was collected. Out of 79 samples from 23 different localities, 63 (79.7%) were awned and 16 (20.3%) were awnless. This species was often found in emmer wheat fields.

Field random sampling was made at 11 different localities using a method described previously. Samples were classified based on species, spike shape and color, awnedness, pubescence, and color of seed (Table 5). Among them two examples are listed below (Collection nos. 2-9-(2)-1 and 2-23-(3)). The first one was sampled on Feb. 9th, 1968 at 45 km from Debre Berhan to Jihur (2680 m alt.), Shoa Province. This consisted of 354 spikes of two species, 111 of *T. durum* and 243 of *T. turgidum*, and classified into the following 14 forms:

(1)	*T. durum* with yellow spike	30 spikes
(2)	*T. durum* with yellow-brown spike	62
(3)	*T. durum* with brown spike	7
(4)	*T. durum* with whitish yellow spike and black color on the margin of glumes	5
(5)	*T. durum* with pubescent and whitish yellow spike	3
(6)	*T. durum* with black spike with yellow awns	2
(7)	*T. durum* with small compact spike	2
(8)	*T. turgidum* with yellow spike	60
(9)	*T. turgidum* with long yellow spike	2
(10)	*T. turgidum* with compact and yellow spike	3
(11)	*T. turgidum* with whitish yellow spike and purple seeds	11
(12)	*T. turgidum* with yellowish brown spike	56
(13)	*T. turgidum* with brown spike	110
(14)	*T. turgidum* with whitish yellow spike and black color on the margin of glumes	1

This sample included one spike of *irregulare-deficiens* barley and two awnless spikes of

Lolium temulentum L.

The second was collected on Feb. 23rd, 1968 at 33 km from Addis Ababa to Ghion (2060 m alt.), Shoa Province. This sample is comprised of 168 spikes (64.4%) of *T. durum* and 93 spikes (35.6%) of *T. turgidum*. The sample was classified into 15 forms based on species, spike and seed color as follows (Fig. 9):

(1)	*T. durum* with yellow spike and yellow seeds	59 spikes
(2)	*T. durum* with yellow spike and purple seeds	23
(3)	*T. durum* with brown spike and yellow seeds	32
(4)	*T. durum* with brown spike and purple seeds	7
(5)	*T. durum* with black spike and yellow seeds	4
(6)	*T. durum* with black spike and purple seeds	2
(7)	*T. durum* with yellow spike but black color on the margin of glumes	14
(8)	*T. durum* with yellow spike but black color on the margin of glumes and purple seeds	16
(9)	*T. durum* with brown-striped yellow spike	6
(10)	*T. durum* with pubescent spike	4
(11)	*T. durum* with brown compact spike	1
(12)	*T. turgidum* with yellow compact spike	9
(13)	*T. turgidum* with yellow and extremely compact spike	33
(14)	*T. turgidum* with pale brown spike and yellow seeds	13
(15)	*T. turgidum* with pale brown spike and purple seeds	9
(16)	*T. turgidum* with black-brown spike and yellow seeds	16
(17)	*T. turgidum* with black-brown spike and purple seeds	13

In addition this sample included seven unidentified sterile spikes and seven spikes infected by *Ustilago*. There was no apparent morphological differences between (1) and (2), (3) and (4), (5) and (6), (7) and (8), (12) and (13), and (14) and (15), respectively, only but different in seed color. Out of 168 spikes of *T. durum*, 48 (28.6%) and 22 (23.7%) among 93 spikes of *T. turgidum* were those having purple-colored seeds.

b. Market collections

45 seed samples of wheats were collected at 16 local markets. Among them two samples of *T. dicoccum* were collected at Addis Ababa (collection no. 12-27-4; Fig. 10) and at Agaro (collection no. 2-20-2). They were sold not as free seeds but as spikelets. No mixed samples of *T. dicoccum* spikelets with other wheat seeds were found.

The wheat seed samples were classified into two groups, yellow colored and purple colored. The results are shown in Table 6 and summarized as follows:

yellow colored seeds only	14 samples (31.1%)
purple colored seeds only	0
yellow + purple colored seeds	29 (64.4)
spikelets of *T. dicoccum*	2 (4.5)
total	45

Samples mixed with yellow and purple seeds were the most frequent and usually yellow colored seeds were predominant in the sample. However, four samples (collection nos.

Table 4. Field collections of wheat

Species	No. of samples
Triticum dicoccum	32
T. durum	287
T. turgidum	95
intermediate between *T. durum* and *T. turgidum*	5
T. polonicum	1
threshed seeds	1
T. aestivum	79
total	500

Table 5. Field random sampling of wheat
Spikes with purple seeds are shown in parentheses.

Collection no.	Locality	Total no. of spikes	*T. aestivum*	*T. durum*	*T. turgidum*	Unidentified emmer	Others
1-23-(2)	65 km from Addis Ababa to Fiche (2600m)	718	84(0)%	12(2)%	—	—	4%
1-23-(3)	92 km from Addis Ababa to Fiche (2600 m)	107	—	35(6)	60(6)%	5(0)%	—
1-26-(1)	*ca.* 40 km from Gondar to Gorgora (2000 m)	157	—	100(0)	—	—	—
2-8-(4)	5 km from Molale to Debre Berhan (3180 m)	253	—	92(0)	8(0)	—	—
2-8-(7)-1	60 km from Debre Berhan to Debre Sina (3100 m)	143	—	99(0)	—	—	1
2-9-(1)-1	25 km from Debre Berhan to Jihur (2600 m)	173	—	8(0)	60(16)	28(0)	4
2-9-(1)-2	25 km from Debre Berhan to Jihur (2600 m)	595	—	11(0)	58(4)	—	31
2-9-(2)-1	45 km from Debre Berhan to Jihur (2680 m)	357	—	31(0)	68(3)	—	1
2-9-(2)-2	45 km from Debre Berhan to Jihur (2680 m)	202	—	53(0)	47(0)	—	—
2-15-(1)	*ca.* 35 km from Addis Ababa to Debre Zeit (2160 m)	592	—	2(0)	51(0)	—	47
2-23-(1)	90 km from Addis Ababa to Ghion (2260 m)	141	—	84(45)	16(0)	—	—
2-23-(3)	33 km from Addis Ababa to Ghion (2060 m)	275	—	61(17)	34(8)	5	—

12-27-3, 1-24-27, 2-29-1 and 2-29-2) contained more than 75% of purple colored seeds.

Most market samples were mixed with seeds of barley, weeds and other cultivated plants, such as sorghum, maize, flax, fenugreek, etc. The mixing rate of alien plant seeds with wheat was examined as shown in Table 6. The plant which quite frequently associated with wheat seeds was *Lolium temulentum*. Out of 45 samples, 43 (95.6%) contained *Lolium* seeds at 0.2–15%. Barley and wild *Avena* were also often found in wheat seed samples.

Table 6. Market collections of wheat

Collection no.	Place collected	No. of seeds examined	Wheat (%)			Others (%)				
			yellow	purple	*T. dicoccum*	barley	*Lolium*	*Avena*	other Gramineae	others
12-27-1	Addis Ababa	565	99.8	—	—	—	0.2	—	—	—
12-27-2	Addis Ababa	194	76.8	8.2	—	—	15.0	—	—	—
12-27-3	Addis Ababa	249	3.6	88.4	—	0.8	6.5	0.4	—	—
12-27-4	Addis Ababa	360	—	—	92.8	—	4.7	1.4	1.1	—
1-13-26	Babile	533	97.6	—	—	—	2.3	—	—	0.2
1-14-70	Alemaya	373	55.8	35.7	—	1.1	6.7	—	—	0.8
1-14-71	Alemaya	362	93.4	3.3	—	—	0.3	0.3	0.6	2.2
1-14-72	Alemaya	521	83.3	9.4	—	0.2	6.9	—	—	0.2
1-14-73	Alemaya	481	81.7	3.5	—	0.4	14.1	—	—	0.2
1-15-1	Harrar	247	98.8	—	—	—	0.4	—	—	0.8
1-15-2	Harrar	361	95.8	3.3	—	0.8	—	—	—	—
1-15-3	Harrar	513	31.8	58.5	—	0.4	8.8	0.4	0.2	—
1-15-4	Harrar	306	95.8	—	—	1.0	2.6	—	0.7	—
1-16-73	Deder	267	94.8	—	—	0.4	4.1	—	0.4	0.4
1-16-74	Deder	490	92.7	—	—	2.2	4.7	—	0.2	0.2
1-16-75	Deder	235	90.2	6.0	—	1.3	2.6	—	—	—
1-16-76	Deder	269	92.2	0.4	—	0.4	5.9	—	1.1	—
1-24-27	Debre Marcos	317	18.6	75.4	—	0.3	5.7	—	—	—
1-24-28	Debre Marcos	422	89.6	1.4	—	1.4	7.1	0.5	—	—
1-25-23	Amsit	516	86.2	—	—	—	13.2	—	0.6	—
1-30-7	Asmara	379	95.5	—	—	2.4	0.3	1.3	0.5	—
1-30-8	Asmara	433	98.2	—	—	0.5	1.2	0.2	—	—
2-2-1	Senafe	518	32.2	54.1	—	4.8	5.4	2.7	0.4	0.4
2-2-2	Senafe	456	83.1	0.4	—	0.2	14.9	1.3	—	—
2-3-1	Makale	240	98.8	—	—	1.2	—	—	—	—
2-3-2	Makale	808	90.3	—	—	—	7.7	0.4	0.5	1.1
2-3-3	Makale	286	92.7	0.7	—	1.4	3.4	—	0.7	1.0
2-3-4	Makale	474	86.5	0.2	—	0.2	11.0	1.1	0.6	0.4
2-3-5	Makale	267	97.8	0.7	—	0.4	0.7	—	—	0.4
2-3-6	Makale	447	97.8	—	—	—	0.9	0.7	0.4	0.2
2-3-78	Bietmara	256	93.8	—	—	—	6.2	—	—	—
2-3-79	Bietmara	544	21.9	68.0	—	0.9	8.3	—	0.9	—
2-5-1	Dessie	504	89.1	9.3	—	0.3	0.3	—	0.3	0.3
2-5-2	Dessie	562	89.3	1.6	—	0.2	5.3	—	—	3.6
2-7-1	Woledi	461	93.9	4.8	—	—	1.1	—	—	0.2
2-7-2	Woledi	685	66.7	28.3	—	0.1	4.2	—	—	0.6
2-7-3	Woledi	519	75.9	12.3	—	—	11.4	—	0.2	0.2
2-10-1	Debre Berhan	412	38.3	56.8	—	—	4.4	—	—	0·5
2-10-2	Debre Berhan	243	97.9	1.6	—	—	0.4	—	—	—
2-20-1	Agaro	274	95.6	—	—	—	4.0	0.4	—	—
2-20-2	Agaro	127	—	—	89.2	—	11.8	—	—	—
2-29-1	Maki	553	4.8	92.2	—	—	2.7	0.2	—	—
2-29-2	Mak	520	10.4	76.5	—	0.2	11.9	—	1.0	—
2-29-3	Maki	487	85.6	4.5	—	1.4	7.4	0.2	—	0.8
2-29-4	Maki	678	91.3	1.8	—	—	6.3	—	0.1	0.4

2. Barley (*Hordeum vulgare* L.)

a. Field collections

207 samples of barley spikes and one seed sample were collected in the fields along the routes. They were classified into 12 classes by the morphological characteristics and spike color as shown in Table 7. In the Table two row-*deficiens* is a two row barley with rudimental sterile lateral spikelets. *Irregulare-deficiens* is a type of spike with irregularily produced fertile spikelets and rudimental sterile lateral spikelets. About a half of the field collections were two row or six row and another half were two row-*deficiens* or *irregulare-deficiens*. Yellow, brown and black colored spikes were found in each group. Several examples of spikes are shown in Fig. 11. Two row-*deficiens*, *irregulare-deficiens* and six row barley were collected in a wide altitude from less than 1500 m to more than 3000 m alt., on the contrary, two row barley was only restricted at 2400–3000 m alt.

Field random sampling of barley was conducted in five different fields as shown in Table 8. *Irregulare-deficiens* and six row barley were most commonly sampled. Wild *Avena* and *Rumex* were frequently associated weeds in barley fields. An example of samples (collection no. 2-20-(3)) is shown as follows. The sample was collected at 5 km from Dembi to Bedele (2100 m alt.), Illubabor Province. 129 spikes of barley were classified into 12 forms according to spike characteristics, spike and awn color.

(1)	six row, yellow spike	6 spikes
(2)	six row, brown spike	1
(3)	six row, black spike	3
(4)	two row-*deficiens*, brown spike with yellow awns	23
(5)	two row-*deficiens*, black spike with brown awns	5
(6)	two row-*deficiens*, black spike with black awns	3
(7)	*irregulare-deficiens*, brown spike with yellow awns	59
(8)	*irregulare-deficiens*, black spike with white awns	3
(9)	*irregulare-deficiens*, black spike with brown awns	9
(10)	*irregulare-deficiens*, black spike with black awns	8
(11)	unidentified due to abnormal growth	7
(12)	infected by *Ustilago*	2

b. Market collections

Along the expedition routes 40 seed samples of barley were gathered at 18 local markets. Barley was sold at most markets. Analysis of the samples are shown in Table 9. In almost all samples, seeds with yellow, brown and black color were mixed together except three samples, collection nos. 12-27-5, 2-7-4 and 2-7-5, which were without black seeds. Only two samples of naked barley were collected at Agaro, Kaffa Province. These two samples of naked barley consisted of yellow, brown and black seeds. A sample (collection no. 2-20-7) contained 66.2% of yellow, 4.9% of brown and 28.9% of black seeds. Mixing rate of the other sample (collection no. 2-20-8) was 68.9% yellow, 21.6% brown and 9.5% black seeds. About 2–5% of hulled barley seeds were mixed in these two samples. In hulled barley samples, on the contrary, naked barley was found sporadically at 0.2–2.2% in six samples. In two samples, collection nos. 2-2-4 and 2-3-12, sorghum seeds were mixed with barley. These might be materials

Table 7. Field collections of barley

Spike characteristics	Spike color			total
	yellow	brown	black	
two row	5	6	3	14 (6.8%)
two row-*deficiens*	21	16	16	53 (25.6)
irregulare-deficiens	21	22	14	57 (27.5)
six row	41	14	28	83 (40.1)
total	88 (42.5%)	58 (28.0)	61 (29.5)	207

Table 8. Field random sampling of barley

Collection no.	Locality	Total number of samples	Two row-*deficiens*	*Irregulare-deficiens*	Six row	Others*	Weeds
1-27-(1)	*ca.* 30 km from Gondar to Dabat (2860 m)	120	20.8%	79.2%	0%	0%	0%
2-8-(3)	5 km from Molale to Debre Berhan (3180 m)	137	0	0	100	0	0
2-8-(6)	Near Molale Junction (3150 m)	171	0	29.2	69.0	1.8	0
2-8-(7)-2	60 km from Debre Berhan to Debre Sina (3100 m)	143	0	8.4	74.8	4.9	11.8
2-20-(3)	5 km from Dembi to Bedele (2100 m)	129	24.0	61.2	7.8	7.0	0

* unidentified due to abnormal growth or infection of *Ustilago*.

of brewing for local people. Out of 40 barley samples, 14 contained wheat seeds but the mixing rate was less than 14% and in 9 samples spikelets of *T. dicoccum* were found. Two kinds of weed, *Lolium temulentum* and wild *Avena*, were closely associated with barley as indicated in Table 9 and Fig. 12. Out of 40 market samples, 25 (65.0%) were mixed with *Lolium* and 29 (72.5%) with *Avena*.

3. Teff (*Eragrostis abyssinica* Schrad.)

a. Field collections

36 samples of teff were collected from 16 localities between 1400 m and 2600 m alt. Cultivation of this crop was mainly concentrated in the central highland. Of 36 samples collected, 14 were white seeds with colorless glumes and 19 were red seeds with colored glumes. However, the remaining three samples were quite different. One sample (collection no. 1-16-31) collected near Deder, Harrar Province, was white seeds with red glumes, another (1-23-32) collected at 50 km from Addis Ababa to Fiche, Shoa Province, was white seeds with black glumes, and the third one (1-24-6) found at 55 km from Dejen to Bebre Marcos, Gojjam Province, was a mixture of white and red seeds. It was often observed that many seeds of teff fell down during harvesting from the spikes. It seemed to be still in an underbred condition.

b. Market collections

26 samples were collected in 14 local markets as shown in Table 10, but it was not

Table 9. Market collections of barley

Collection no.	Place collected	No. of seeds examined	Barley (%)				Others (%)					
			yellow	brown	black	naked	wheat	*T. dicoccum*	*Lolium*	*Avena*	other Gramineae	others
12-27-5	Addis Ababa	311	77.5	11.9	—	—	—	—	9.0	1.3	0.3	—
12-27-6	Addis Ababa	385	1.3	0.3	95.6	—	0.8	—	—	2.0	—	—
12-27-7	Addis Ababa	410	12.4	7.8	57.8	—	—	—	19.0	2.2	0.2	0.5
1-10-14	Awash Sta.	260	23.5	70.4	1.2	—	—	1.5	0.4	1.2	1.9	—
1-14-69	Alemaya	340	50.0	49.1	0.6	—	0.3	—	—	—	—	—
1-15-5	Harrar	440	3.2	94.3	0.7	—	0.5	0.5	—	—	—	0.9
1-16-78	Deder	525	37.7	38.1	6.9	—	0.6	0.2	6.1	0.4	9.9	0.2
1-24-32	Debre Marcos	363	17.9	37.5	21.2	0.6	0.3	—	3.0	17.1	1.1	1.4
1-25-21	Amsit	385	0.5	75.1	0.8	—	—	—	23.4	—	0.3	—
1-25-22	Amsit	481	13.9	67.6	9.8	0.4	—	—	6.2	1.7	0.4	—
1-30-4	Asmara	421	54.4	33.3	10.7	—	—	—	—	0.2	—	1.4
1-30-6	Asmara	395	25.8	67.3	2.0	—	—	—	0.5	2.0	1.5	0.8
2-2-3	Senafe	405	28.6	47.4	2.2	—	12.8	—	3.2	5.2	0.5	—
2-2-4	Senafe	548	27.9	25.9	0.5	—	12.8	—	1.5	1.1	30.3	—
2-3-7	Makale	416	11.1	57.0	16.1	—	1.7	0.7	7.0	6.0	0.2	0.2
2-3-8	Makale	363	2.2	9.1	63.6	—	3.3	0.6	7.7	10.2	2.8	0.6
2-3-9	Makale	338	42.0	17.5	10.7	—	0.6	—	15.4	13.0	—	0.9
2-3-12	Bietmara	641	11.2	12.5	1.6	—	13.7	1.9	4.5	3.9	50.5	0.2
2-3-80	Bietmara	387	46.5	41.1	3.1	—	0.3	—	3.0	6.2	0.3	—
2-3-81	Bietmara	305	42.6	23.3	32.8	—	0.7	—	—	—	0.3	0.3
2-5-3	Dessie	250	30.8	40.0	28.8	—	—	—	—	—	—	0.4
2-5-4	Dessie	470	58.3	21.3	5.5	—	0.2	1.1	9.8	3.0	—	0.9
2-5-5	Dessie	354	79.4		19.8	—	—	0.6	—	—	0.3	—
2-5-6	Dessie	287	21.6	52.3	26.1	—	—	—	—	—	—	—
2-7-4	Woledi	276	8.7	89.1	—	—	—	—	—	1.8	0.4	—
2-7-5	Woledi	290	5.5	93.4	—	—	—	—	—	0.7	0.3	—
2-10-3	Debre Berhan	333	9.0	72.7	13.8	0.6	—	—	—	3.0	—	0.9
2-10-4	Debre Berhan	413	7.7	9.0	59.1	—	—	—	0.5	23.0	—	0.7
2-10-5	Debre Berhan	344	50.9	37.8	4.4	—	—	—	—	3.8	2.0	1.2
2-20-3	Agaro	320	88.8	2.2	3.4	2.2	—	—	1.6	—	0.3	1.6
2-20-4	Agaro	363	81.5	8.0	1.7	—	—	0.6	5.2	1.1	0.3	1.7
2-20-5	Agaro	424	4.2	2.4	87.5	0.7	—	—	2.8	1.9	0.2	0.2
2-20-6	Agaro	509	13.2	3.9	71.5	0.2	—	—	—	—	—	10.4
2-20-7	Agaro	584	0.9	0.9	0.5	97.3	—	—	—	0.2	—	0.3
2-20-8	Agaro	356	2.0	0.8	2.0	97.4	—	—	0.3	0.3	—	—
2-27-5	Mazoro	406	1.5	46.3	34.5	—	—	—	17.7	—	—	—
2-27-24	Ajo	324	30.9	63.0	6.2	—	—	—	—	—	—	—
2-27-25	Ajo	426	84.5	8.0	1.6	—	—	—	1.9	4.0	—	—
2-29-5	Maki	470	1.7	6.4	81.7	—	—	—	7.8	0.9	1.1	0.4
2-29-6	Maki	381	3.8	89.2	3.4	—	—	—	0.5	3.1	—	—

found from the markets in the southern part. The teff seeds are very small, 1.0–1.5 mm long and 0.8–1.0 mm wide, and the 100 seed weight was 30–40 mg (Fig. 13). In most cases white and red seeds were sold as a mixture at the market. In 14 samples seeds of an unidentified Gramineae were often mixed with teff. This weed seems to be very closely associated with teff cultivation.

4. Sorghum (*Sorghum bicolor* Moench.)

a. Field collections

58 samples of cultivated sorghum were collected at 11 localities between 1240 m and 2180 m alt., and at the same time five samples of weedy wild sorghum were also collected

Table 10. Market collections of teff

Collected no.	Place collected	No. of seeds examined	Seed color		Seeds of other cultivated plants			Weed seeds
			white	red	sorghum	maize	flax	
12-27-8	Addis Ababa	488	96.3%	2.5%	—	—	—	0.8%
12-27-9	Addis Ababa	324	75.3	23.5	—	—	—	0.9
12-27-10	Addis Ababa	340	33.2	62.4	—	—	—	4.3
1-14-74	Alemaya	449	88.2	7.8	—	—	—	4.0
1-15-10	Harrar	480	28.3	71.7	—	—	—	—
1-15-11	Harrar	311	100.0	—	—	—	—	—
1-15-12	Harrar	506	92.5	5.3	—	—	—	2.2
1-16-81	Deder	464	57.8	38.8	—	—	1.9%	1.5
1-25-13	Amsit	660	17.6	76.8	—	—	—	5.7
1-25-14	Amsit	480	—	100.0	—	—	—	—
1-30-1	Asmara	302	77.5	11.9	—	—	—	10.6
1-30-2	Asmara	390	30.8	66.2	—	—	—	3.1
2-2-5	Senafe	700	4.9	91.0	—	—	—	4.1
2-3-10	Makale	540	1.1	89.4	—	—	—	9.5
2-3-11	Makale	647	77.8	17,3	—	—	—	5.3
2-3-82	Bietmara	711	1.5	97.9	—	—	—	0.5
2-3-83	Bietmara	431	75.4	23.4	—	—	—	1.1
2-4-1	Urgessa	426	77.8	9.9	—	—	—	12.4
2-5-7	Dessie	505	66.3	32.5	—	—	—	1.2
2-5-8	Dessie	397	70.8	25.7	—	—	—	3.0
2-5-9	Dessie	441	2.3	97.8	—	—	—	—
2-5-10	Dessie	335	6.9	92.8	—	—	—	0.3
2-7-6	Woledi	746	89.8	4.3	—	—	—	5.9
2-7-7	Woledi	607	56.8	15.5	—	—	—	27.7
2-22-1	Goro	479	84.1	5.4	2.9%	0.6%	—	6.8
2-29-9	Maki	484	3.3	92.1	—	—	—	4.5

Table 11. Field collections of sorghum

Shape of spike	No. of spikes with the following seed color:				total
	white-yellow	yellowish amber-amber	yellowish brown-dark brown	reddish brown-red	
compact	8	8	5	1	22
spreading	4	0	20	9	33
total	12	8	25	10	55

at four localities between 1420 m and 2000 m alt. Sorghum is cultivated throughout Ethiopia from the mountainous districts to the arid low lands, but extensive cultivation was observed particularily in the eastern and northern parts. The variation of shape and color of seeds and spike of our collection was very high as given in Table 11. Even in a sorghum field quite different types were collected as shown in Fig. 14 which were

Table 12. Market collections of sorghum

Collection no.	Place collected	No. of seeds examined	Seed color							100 seed weight
			pearl white	chalky white or grey	bright yellow	brownish yellow	brown	dark brown	others	
12-27-13	Addis Ababa	341	88.2%	—	—	2.9%	1.5%	1.5%	5.9%	2.2g
12-27-14	Addis Ababa	505	—	—	—	—	2.4	97.6	—	1.8
12-27-15	Addis Ababa	363	3.1	3.6%	25.3%	12.6	2.8	1.7	50.7	3.7
1-10-16	Awash Station	351	—	—	—	27.9	29.1	3.1	37.3	5.0
1-13-21	Babile	346	28.9	0.9	1.4	2.9	4.1	1.5	60.4	3.6
1-13-25	Babile	376	72.9	6.4	—	12.2	4.6	1.6	0.8	2.8
1-14-76	Alemaya	304	7.2	1.3	—	46.0	18.6	—	26.6	3.2
1-15-8	Harrar	344	—	—	12.5	0.6	0.6	3.5	82.8	2.9
1-15-9	Harrar	373	84.9	2.9	—	6.5	0.3	0.3	5.4	2.3
1-16-79	Deder	307	33.2	—	7.9	15.4	3.0	3.6	19.2	2.7
1-16-80	Deder	362	52.0	—	—	0.6	—	—	47.2	2.5
1-25-26	Amsit	344	—	—	—	—	1.1	99.9	—	2.0
1-30-11	Asmara	322	1.8	1.2	—	82.7	12.2	2.8	—	2.6
1-30-12	Asmara	334	68.8	0.3	0.6	10.2	0.6	7.2	12.3	3.0
1-30-13	Asmara	416	20.4	17.1	1.0	19.7	19.5	5.1	17.3	3.2
1-30-14	Asmara	335	—	0.6	23.9	6.6	0.3	0.3	68.4	3.9
1-30-15	Asmara	356	—	93.6	0.3	—	—	0.3	2.8	2.7
2-2-7	Senafe	321	5.9	0.3	44.3	4.1	—	1.2	44.2	4.0
2-2-8	Senafe	478	—	—	—	—	—	100.0	—	1.1
2-3-13	Makale	320	67.5	4.7	—	13.8	7.5	2.5	3.8	3.6
2-3-14	Makale	373	0.3	—	11.0	0.3	2.6	2.2	83.6	3.7
2-3-15	Makale	334	1.2	1.8	12.0	0.9	1.5	6.4	77.0	4.0
2-3-16	Makale	391	—	—	—	—	—	100.0	—	2.0
2-3-86	Bietmara	388	11.6	—	8.0	6.7	0.3	0.3	73.2	3.9
2-3-87	Bietmara	372	—	—	—	—	1.4	98.4	0.3	1.9
2-4-3	Urgessa	349	—	3.7	16.6	1.2	0.3	0.3	67.9	3.8
2-5-13	Dessie	425	2.3	3.8	30.3	—	1.7	2.8	57.4	3.9
2-5-14	Dessie	344	—	—	—	—	2.0	88.1	2.3	2.4
2-5-15	Dessie	441	—	19.9	18.6	8.7	21.1	29.9	1.8	2.9
2-5-16	Dessie	339	21.5	—	3.9	—	2.4	57.3	15.0	3.0
2-7-9	Woledi	351	1.5	4.0	17.9	2.6	1.7	23.9	45.6	3.1
2-7-10	Woledi	333	2.1	—	10.2	0.6	3.3	18.3	64.9	3.4
2-7-11	Woledi	302	22.5	0.6	10.9	—	1.4	—	63.9	4.4
2-7-12	Woledi	428	8.0	—	6.0	2.8	2.6	54.0	26.6	2.9
2-10-7	Debre Berhan	299	16.7	4.0	36.1	4.3	3.0	7.1	28.4	4.0
2-10-8	Debre Berhan	451	—	—	—	—	7.0	92.0	—	1.9
2-20-10	Agaro	368	9.5	78.7	—	7.3	7.3	3.3	—	1.3
2-22-5	Goro	349	—	—	—	4.9	89.4	5.7	—	2.7
2-27-11	Mazoro	412	—	0.7	—	—	4.1	95.2	—	2.1
2-29-8	Maki	346	—	—	—	—	—	100.0	—	1.8

observed in a field at 3 km from Asbe Tafari to Alemaya (1800 m alt.), Harrar Province.

b. Market collections

45 samples of sorghum were collected at 20 markets. Among them 40 samples were classified based on size and color of seeds (Table 12). Brown and dark brown seeds were very common in Ethiopia. In the eastern part, however, pearl white or brownish yellow seeds were rather common. The 100 seed weight varied from 1.1 to 5.0 g with the average of 2.9 g.

5. Finger millet (*Eleusine coracana* Gaertn.)

a. Field collections

11 samples of finger millet were collected at three localities between 1400 m and 1920 m alt. It was mainly cultivated in the northern part but cultivation was observed also around Lake Tana and in the southern part (Fig. 15). Out of 11, only one sample was white seeds, while the rest were all brown or black seeds.

b. Market collections

Eight samples were collected at six markets, however, this crop could not be found at all in the local markets in the eastern and southern parts (Table 3). Seed color variation and mixing rate of weed seeds were examined as given in Table 13. Black colored seeds were predominant in all the samples collected. Seeds of an unidentified wild Gramineae were often found in the samples. In a sample, collection no. 2-27-30, collected at Ajo, Shoa Province, 19 per cent of sorghum seeds were observed. The 100 seed weight was 0.2–0.3 g.

6. Maize (*Zea mays* L.)

a. Field collections

19 samples of maize were collected at six localities between 1350 m and 2320 m alt. In the eastern part, maize was cultivated even at the altitude around 2400 m, but in the central highland it was found at relatively low altitudes. This crop was often found also in the southwestern part. Among 16 samples examined, there were three with red cobs and 13 with white cobs. Only three samples were pop corn.

b. Market collections

32 samples were collected at 19 markets, consisting of nine tassel samples and 23

Table 13. Market collections of finger millet

Collected no.	Place collected	No. of seeds examined	Seed color						Weed seeds	Sorghum seed	100 seed weight
			white	yellow	light brown	brown	dark brown	black			
2-27-12	Addis Ababa	386	9.3%	0.3 %	2.0%	0.5%	2.3%	78.8%	6.7%	—	0.2g
1-25-10	Amsit	346	1.4	—	0.9	1.7	2.3	68.5	25.1	—	0.2
1-30-3	Asmara	449	0.7	—	—	2.0	12.5	84.6	0.2	—	0.3
1-30-5	Asmara	685	1.8	0.3	—	11.5	7.2	69.3	—	—	0.3
2-2-6	Senafe	349	—	—	0.2	0.6	11.7	86.8	0.4	—	0.2
2-20-11	Agaro	427	31.1	0.5	3.3	3.3	4.9	47.1	9.8	—	0.2
2-27-29	Ajo	376	8.0	—	25.8	6.9	21.8	37.5	—	—	0.3
2-27-30	Ajo	463	0.9	—	0.4	9.3	31.5	38.7	—	19.2%	0.3

threshed ones. The variation of seed color per tassel of the former nine samples collected at three different markets was examined (Table 14). Seed characteristics of 22 threshed samples were studied and the results are shown in Table 15. The frequency of dent corn is in parentheses. Albumen color of most samples was white, whitish yellow or yellow. The average frequency of seeds with colored aleurone layer was 14 per cent. A higher frequency of dent corn type was observed in the seeds with white or whitish yellow

Table 14. Market collections of maize seeds with cobs
Dent corn type is shown in parentheses.

Collection no.	Place collected	Albumen colour			Aleurone layer colour				Abnormal seed	100 seed weight
		white	white yellow	yellow	brownish yellow	brown	purple	mottled		
1-16-77a	Deder	—	—	—	—	87%	13%	—	—	29.7g
1-16-77b	Deder	—	12%	22%	49%	—	9	8%	—	21.3
1-16-77c	Deder	—	—	97	—	—	—	3	—	22.7
2-22-3	Goro	88(88)%	12(12)	—	—	—	—	—	—	28.9
2-22-4	Goro	91(51)	9(7)	—	—	—	—	—	—	28.6
2-27-7	Ajo	—	—	—	—	100(8)	—	—	—	33.0
2-27-8	Ajo	47(5)	34(16)	9	—	—	6(3)	3(1)	1%	18.8
2-27-9	Ajo	78(29)	4(1)	—	—	—	13(2)	4(1)	1	26.9
2-27-10	Ajo	40(19)	10(4)	—	—	—	50(20)	—	—	31.4

Table 15. Market collections of maize
Dent corn type is shown in parentheses (pop corn type with asterisk).
Analysis based on 100 seeds.

Collection no.	Place collected	Albumen color			Aleurone layer color					100 seed weight
		white	white yellow	yellow	brownish yellow	brown	purple	mottled	Others	
12-27-11	Addis Ababa	36(8)%	40(6)%	12%	1%	2%	2%	—	7%	17.8g
1-10-17	Awash Station	51(10)	17	11	6(1)	5	3	3%	4	17.8
1-13-40	Babile	8	44(1)	37(1)	3	1	2	3	2	17.5
1-15-6	Harrar	4	42(1)	39	9	—	3	3	—	16.3
1-15-7	Harrar	62(60)	24(24*)	8(5*)	—	—	—	5(5)	1	10.4
1-24-33	Debre Marcos	44(2)	31	—	—	9	6(1)	9	—	24.1
1-25-19	Amsit	7	18	16	8	6	13	31	1	22.8
1-25-20	Amsit	7	32	37	9	3	2	4	6	21.4
1-30-9	Asmara	84(36)	12(5)	—	—	1	—	1(1)	3	23.2
1-30-10	Asmara	20(1)	45(5)	23(2)	5	3(2)	1(1)	1	—	22.4
2-2-9	Senafe	8(1)	47(1)	28(2)	2	—	5(1)	6	4	20.6
2-3-17	Makale	—	27(1)	48(1)	18	3	1	1	2	22.9
2-3-84	Bietmara	13	48(6)	30(2)	2	—	1	3	3	20.8
2-3-85	Bietmara	—	29	47	12	—	—	1	11	10.3
2-5-11	Dessie	45(8)	13(6)	9(1)	—	1(1)	1	22(6)	9	19.9
2-5-12	Dessie	29(7)	49(8)	4	—	—	3(1)	2	13	21.1
2-7-8	Woledi	52(14)	24(10)	8(1)	—	—	1	11	3	22.5
2-20-9	Agaro	100(69)	—	—	—	—	—	—	—	31.7
2-22-2	Goro	63(28)	20(8)	4(1)	—	6(3)	5(3)	2	—	33.4
2-27-6	Mazoro	72(16)	32(6)	1	—	—	—	4	—	23.6
2-27-26	Ajo	75(43)	12(6)	3(1)	—	1(1)	5(5)	4	—	28.4
2-29-7	Maki	39(12)	40(4)	11	5	1(1*)	1(1)	1	1	16.6

albumens. Pop corn was found only in a sample, collection no. 1-15-7, collected at Harrar, Harrar Province.

7. Field pea (*Pisum sativum* L.)

a. Field collections

Eight samples were collected at three localities. Seed fertility, average number of seed per pod and seed color of three samples, collection nos. 1-5-49, 1-5-70 and 1-16-68, were examined as shown in Table 16. Seed fertility was 70–80 per cent, and the average number of seed per pod was five.

b. Market collections

31 seed samples collected at 17 markets were classified into eight forms based on hilm color and shape and color of seeds (Table 17). Seeds with angular shape, single seed color and brown hilm were the most common in the present collections. Those with roundish shape, single seed color and brown hilm were mostly occurred in the central part. Mottled seeds with black hilm found only as a mixture of other types in the samples collected at Addis Ababa, Harrar, Agaro and Maki (collection nos. 12-27-20, 1-15-22, 2-20-14 and 2-29-14) (Fig. 16). Two samples with black hilm, collection nos. 2-4-5 and 2-5-25, were clearly smaller and 100 seed weights of these two samples were 11.4 g and 11.2 g, respectively, compared with others which were 16.9 g on the average.

8. Chick pea (*Cicer arietinum* L.)

a. Field collections

Five samples of chick pea were collected at four localities from 1780 m to 2060 m alt. The seeds of a sample (collection no. 12-29-11) collected at 4 km south of Debre Zeit, Shoa Province, were a mixture of yellow, green, light green, light brown and brown. Those of other samples were all brown. Average numbers of seed per pod was 1.3 examining 500 pods. It was often observed by the authors that people carrying a bundle of chick pea plants were eating immature seeds taken from the pods.

b. Market collections

24 samples were collected from 14 markets. Chick pea was one of the most common legumes in Ethiopian local markets. Table 18 shows an analysis of seed color variations and the percentage of roundish seeds in each sample. Seeds with light brown, whitish yellow, black or brown color were found commonly (Fig. 17). The roundish seeds were very rare in the markets of the northern part; on the contrary, they were quite predominant in the samples collected at Agaro. White seeds were also very rare in the northern part.

9. Lentil (*Lens esculenta* Moench.)

a. Field collections

Only one sample, collection no. 2-19-33, was collected in a field at 45 km from Addis Ababa to Ghion (2080 m alt.), Shoa Province. The seed color of this sample was brown with black dots. A pod contained one or two seeds and the average number of seeds was 1.7.

Table 16. Field collections of field pea

Collection no.	Locality	No. of pods	Average seeds per pod	No. of pods with: green seeds	No. of pods with: mottled seeds	Seed fertility(%)
1-5-49	Mt. Erer, east of Debre Zeit (2750m alt.)	4	5.3	4	0	70.0
1-5-70	Mt. Erer, east of Debre Zeit (2750m alt.)	10	4.4	8	2	74.6
1-16-68	On a hill near Deder (2600m alt.)	21	5.0	21	0	88.9

Table 17. Market collections of field pea
Analysis based on 100 seeds.

Collection no.	Place collected	Brown hilum single color roundish	Brown hilum single color angular	Brown hilum mottled roundish	Brown hilum mottled angular	Black hilum single color roundish	Black hilum single color angular	Black hilum mottled roundish	Black hilum mottled angular	100 seed weight
12-27-19	Addis Ababa	71%	22%	1%	4%	—	—	—	2%	17.6g
12-27-20	Addis Ababa	24	21	2	8	2%	5%	11%	27	17.6
1-14-79	Alemaya	34	63	—	3	—	—	—	—	14.5
1-15-19	Harrar	19	72	3	6	—	—	—	—	17.1
1-15-22	Harrar	35	33	1	9	—	1	4	17	14.5
1-16-69	Harrar	23	67	2	8	—	—	—	—	16.1
1-16-84	Deder	22	70	3	4	—	1	—	—	15.7
1-24-29	Debre Markos	4	59	2	35	—	—	—	—	17.9
1-25-24	Amsit	—	78	—	22	—	—	—	—	18.8
1-25-25	Amsit	1	95	—	4	—	—	—	—	19.4
1-30-21	Asmara	—	82	1	17	—	—	—	—	18.4
2-3-21	Makale	2	67	2	29	—	—	—	—	16.8
2-3-23	Makale	6	69	5	20	—	—	—	—	18.9
2-3-93	Bietmara	—	58	4	38	—	—	—	—	19.2
2-4-5	Urgessa	—	—	—	—	98	2	—	—	11.4
2-4-6	Urgessa	—	35	4	44	—	17	—	—	17.9
2-5-23	Dessie	3	71	1	25	—	—	—	—	17.4
2-5-24	Dessie	2	66	—	32	—	—	—	—	17.8
2-5-25	Dessie	—	—	—	—	86	14	—	—	11.2
2-7-13	Woledi	6	65	4	25	—	—	—	—	17.5
2-7-14	Woledi	2	68	4	26	—	—	—	—	18.2
2-7-15	Woledi	2	69	5	24	—	—	—	—	18.2
2-8-1	Molale	15	60	5	18	—	1	1	—	14.2
2-8-29	Debre Berhan	13	57	4	23	—	3	—	—	17.2
2-10-10	Debre Berhan	—	50	1	49	—	—	—	—	19.5
2-10-11	Debre Berhan	3	51	7	34	—	3	1	1	17.0
2-20-12	Agaro	59	30	—	9	2	—	—	—	16.3
2-20-13	Agaro	—	9	1	14	12	63	—	1	18.8
2-20-14	Agaro	4	53	3	17	—	8	3	12	18.0
2-27-32	Ajo	14	75	1	10	—	—	—	—	15.2
2-29-14	Maki	38	17	1	7	1	1	8	27	14.7

b. Market collections

19 samples were collected from 15 local markets. Seeds of 16 samples were classified into seven groups based on their seed color (Table 19). All seeds were mottled with black dots and brown or dark brown seeds were the most common in all the samples collected. 1–22 per cent of black seeds were found in all market samples except that collected from Bietmara. The average 100 seed weight was 3.0 g and no appreciable variation was found.

10. Horse bean (*Vicia faba* L.)

a. Field collections

Four samples were collected from three localities. Two samples, collection no. 12-29-42 and 12-29-62, were found in a field of horse bean growing with field pea and *Phaseolus* in the suburbs of Debre Zeit, Shoa Province. The remaining two samples, 1-16-70 and 1-16-71, were collected at a hill near Deder (2600 m alt.), Harrar Province. The average seed numbers per pod was 2.7.

b. Market collections

24 samples were collected from 17 markets and one from a farmer's house near Debre

Table 18. Market collections of chick pea
Analysis based on 100 seeds.

Collection no.	Place collected	Seed color									Percentage of roundish seeds	100 seed weight
		white	white yellow	light brown	brown	light green	green	light grey	grey	black		
12-17-27	Addis Ababa	18%	9%	27%	13%	—	1%	10%	6%	16%	29%	11.0g
12-27-16	Addis Ababa	17	12	20	14	—	—	21	14	2	17	12.1
1-13-37	Babile	—	27	33	8	7%	4	1	3	17	1	11.7
1-14-80	Alemaya	3	27	20	14	—	—	6	11	19	4	11.4
1-15-16	Harrar	3	21	38	1	—	—	4	11	22	8	11.4
1-15-17	Harrar	16	19	17	7	16	9	7	3	6	9	11.1
1-24-31	Debre Markos	14	22	40	7	1	7	4	2	3	7	11.9
1-30-17	Asmara	2	9	49	22	11	—	3	3	1	0	14.4
2-3-18	Makale	2	24	14	15	14	4	14	2	11	0	11.0
2-3-19	Makale	—	7	15	18	8	1	28	1	22	0	13.5
2-3-20	Makale	—	6	42	19	3	12	—	—	18	0	13.8
2-3-88	Bietmara	—	14	16	3	8	2	24	12	21	0	13.5
2-3-89	Bietmara	—	29	18	9	—	7	18	12	7	1	11.4
2-5-17	Dessie	—	24	41	22	—	9	—	—	4	0	13.0
2-5-18	Dessie	—	9	29	12	10	14	—	20	6	1	11.6
2-5-19	Dessie	—	5	37	30	12	2	—	—	14	0	12.5
2-7-19	Woledi	6	34	10	13	9	6	10	2	10	0	12.6
2-10-9	Debre Berhan	—	14	53	19	9	2	—	—	3	0	12.4
2-20-15	Agaro	7	23	22	19	2	2	—	—	25	4	12.3
2-20-16	Agaro	70	16	3	—	10	—	1	—	—	91	11.5
2-20-17	Agaro	41	19	1	1	34	2	2	—	—	79	9.3
2-22-10	Goro	1	9	27	8	—	1	25	22	7	2	12.9
2-29-12	Maki	3	19	47	5	9	2	9	4	2	3	10.2
2-29-13	Maki	—	6	11	8	3	7	—	4	61	2	12.0

Berhan. They were divided into seven classes based on seed color as shown in Table 20. Seeds with green or brown color were found frequently. Black seeds were very rarely observed. Although the average 100 seed weight was 38.4 g, the variation of seed weight was rather high ranging from 28.2 to 50.5 g.

11. *Vigna* spp.

No field samples were collected during our expedition, however, seven samples were obtained from five local markets mainly in the eastern part. These samples were analysed based on seed color as shown in Table 21. Seeds with terra cotta and buff color were the most common. White seeds were only found at the market of Asmara, while mottled seeds were obtained from a sample collected at Alemaya (Fig. 18). Black seeds were found in a few samples.

12. *Phaseolus* spp.

a. Field collections

Three samples were collected in Debre Zeit (1850 m alt.), Shoa Province, and Kurubi (2320 m alt.), Harrar Province. Two samples collected in Debre Zeit were brown seeds with a black stripe and white seeds. A sample from Kurubi was white. The average number of seeds per pod was 4.3 and seed fertility was 91.9 per cent.

b. Market collections

13 samples were collected from six markets. At the market of Harrar, various types were observed but often mixed with *Vigna* seeds. In the central and northern parts *Phaseolus* was found only at the market of Dessie, Wollo Province. White seeds were the

Table 19. Market collections of lentil
Analysis based on 100 seeds.

Collection no.	Place collected	Seed color							100 seed weight
		mottled with black dots						black	
		dark yellow	lustrous brown	brown	dark brown	green	grey		
12-27-17	Addis Ababa	—	8%	45%	45%	—	—	2%	3.0g
1-13-31	Babile	—	6	72	17	—	2	3	2.7
1-15-20	Harrar	—	2	51	28	2	7	10	2.6
1-16-85	Deder	1%	3	49	39	—	3	5	2.5
1-25-17	Amsit	—	13	62	22	1	—	2	2.8
1-30-23	Asmara	—	1	51	47	—	—	1	3.2
2-3-26	Makale	—	—	67	24	—	2	7	3.2
2-3-94	Bietmara	—	2	76	22	—	—	—	3.3
2-4-2	Urgessa	—	5	67	24	—	—	4	3.2
2-5-28	Dessie	1	2	34	54	—	7	2	2.9
2-7-22	Woledi	2	4	26	63	—	1	4	3.4
2-8-2	Molale	—	2	35	40	—	1	22	3.3
2-10-14	Debre Berhan	—	1	44	53	—	1	1	3.2
2-20-20	Agaro	—	8	69	20	—	1	2	3.0
2-22-11	Goro	—	6	45	30	1	1	17	2.9
2-29-15	Maki	—	5	49	40	—	—	6	2.6

most abundant in the present collections (Table 22 and Fig. 19).

Only one sample of black gram (*Phaseolus mungo* L.) was collected at Awash Station, Shoa Province. The sample indicated that 93 per cent of the seeds were green, 3 per cent buff and the remaining 3 per cent black (Table 23).

Table 20. Market collections of horse bean
Analysis based on 100 seeds.

Collection no.	Place collected	Seed color							100 seed weight
		light green	green	light brown	brown	light grey	grey	black	
12-27-18	Addis Ababa	28%	5%	27%	22%	10%	6%	2%	37.8g
1-15-14	Harrar	48	7	23	3	14	5	—	39.6
1-16-86	Deder	49	3	36	6	6	—	—	45.5
1-24-30	Debre Markos	39	2	28	14	16	1	—	28.8
1-25-31	Amsit	39	5	46	5	5	—	—	33.6
1-25-32	Amsit	45	1	15	23	13	2	1	34.9
1-30-18	Asmara	41	2	37	7	9	4	—	33.6
2-3-22	Makale	46	1	34	—	12	5	2	31.3
2-3-92	Makale	53	6	19	2	17	3	—	34.9
2-3-95	Bietmara	37	4	24	5	17	13	—	36.2
2-4-4	Urgessa	37	5	26	20	8	4	—	50.5
2-5-27	Dessie	35	3	21	16	18	7	—	30.5
2-7-16	Woledi	36	—	42	1	11	8	2	46.7
2-7-17	Woledi	28	1	31	24	16	—	—	44.0
2-9-23	Debre Berhan	37	—	25	18	16	3	1	28.2
2-10-12	Debre Berhan	43	7	22	5	21	2	—	32.3
2-10-13	Debre Berhan	30	10	30	6	17	7	—	39.8
2-20-18	Agaro	33	1	32	9	21	4	—	31.9
2-20-19	Agaro	27	3	38	24	4	3	1	43.1
2-22-9	Goro	14	—	53	6	23	4	—	35.7
2-27-12	Ajo	15	—	51	4	24	5	1	44.2
2-27-33	Ajo	30	7	30	11	14	8	—	44.7
2-29-10	Maki	15	1	45	2	32	3	2	47.4
2-29-11	Maki	11	—	47	17	20	2	3	45.2

Table 21. Market collections of *Vigna* spp.
Analysis based on 100 seeds.

Collection no.	Place collected	Seed color							100 seed weight
		single color						mottled	
		white	banana	buff	terra cotta	horse chestnut	black		
1-13-39	Babile	—	6%	6%	70%	18%	—	—	11.0g
1-14-78	Alemaya	—	22	6	2	—	5%	65%	6.1
1-15-13	Harrar	—	13	71	8	—	1	7	15.0
1-15-21	Harrar	—	1	—	32	67	—	—	8.9
1-30-19	Asmara	1%	13	35	25	6	12	8	8.6
1-30-20	Asmara	100	—	—	—	—	—	—	7.0
2-7-20	Woledi	—	15	25	34	10	9	7	10.7

13. Grass pea (*Lathyrus sativus* L.)

Only one field sample was collected in a field at 77 km from Adi Abun to Asmara (1940 m alt.), Eritrea Province. The average seed per pod was 2.6 and seed fertility was 86.7 per cent.

Seven market samples were collected from six local markets as shown in Table 24. Tht majority of seeds were mottled (Fig. 20).

Table 22. Market collections of *Phaseolus* spp.
Analysis based on 100 seeds.

Collection no.	Place collected	Seed color									*Vigna* spp.	100 seed weight
		single color								mottled		
		white	green muscat	string	mace	beech brown	terra cotta	dark brown	black			
1-13-41	Babile	47%	—	5%	44%	—	1%	—	—	3%	—	24.4g
1-14-77	Alemaya	97	—	—	—	—	—	2%	—	1	—	15.1
1-14-91	Alemaya	15	1%	—	3	—	—	81	—	—	—	30.0
1-15-15	Harrar	65	—	8	6	7%	1	—	4%	9	—	21.1
1-15-18	Harrar	74	—	—	1	—	—	—	1	13	11%	16.9
1-16-83	Deder	99	—	—	—	—	—	1	—	—	—	14.5
2-5-20	Dessie	95	3	—	2	—	—	—	—	1	1	14.7
2-5-21	Dessie	95	1	—	1	—	—	—	2	1	—	15.2
2-27-31	Ajo	22	—	2	1	—	1	4	1	69	—	39.4
2-29-16	Maki	100	—	—	—	—	—	—	—	—	—	15.0
4-27-2	Harrar	15	1	2	62	—	4	—	12	4	—	39.3
4-27-3	Harrar	17	—	1	2	4	—	3	—	72	1	43.5
4-27-4	Harrar	37	—	3	23	6	—	2	1	5	23	24.1

Table 23. Market collection of black gram (*Phaseolus mungo*)
Analysis based on 100 seeds.

Collection no.	Place collected	Seed color			100 seed weight
		green	buff	black	
1-10-15	Awash Station	93%	3%	3%	3.9g

Table 24. Market collections of grass pea
Analysis based on 100 seeds.

Collection no.	Place collected	Seed color		100 seed weight
		single color	mottled	
1-25-15	Amsit	1%	99%	7.4g
1-30-22	Asmara	7	93	10.4
2-3-27	Makale	3	97	9.0
2-5-26	Dessie	12	88	9.2
2-7-18	Woledi	13	87	9.3
2-22-12	Goro	—	100	7.9
2-22-13	Goro	—	100	8.0

DISCUSSION

1. Wheat

During 1926–1927 Vavilov collected various forms of cultivated wheats in Ethiopia and he found an astonishing wealth of endemic variation in cultivated emmer wheats (Vavilov *et al.* 1931). Vavilov classified his collections as follows: *Triticum durum* subsp. *abyssinicum* Vav. including 106 varieties, *T. turgidum* subsp. *abyssinicum* Vav. including 96 vars., *T. polonicum* subsp. *abyssinicum* Steud. including 5 vars. and *T. dicoccum* subsp. *abyssinicum* including 6 vars. From this study he concluded that the center of diversity of cultivated emmers is at Abyssinia and its neighboring mountain regions.

The present field collections of wheat indicated an abundance of both *T. durum* and *T. turgidum* in the wheat fields and usually these two species were cultivated as mixed populations. As the variation from *durum* type to *turgidum* type was rather continuous, it was often difficult to classify our collections in the fields. In this respect Vavilov (1928) stated that "*Dabei ist hier das Auseinandergehen der Arten nicht so scharf ausgeprägt, und nicht selten fallt es schwer, auf den Feldern Abessiniens die verschiedenen Weizenarten auseinanderzuhalten. Die Divergenz der Arten ist hier noch nicht ganz ausgepragt.*" One of our randomly collected samples, collectiod no. 2-23-(3), clearly indicates this situation. Namely, 275 spikes of the sample could be classified into 11 different forms based on the shape and color of spikes. Moreover, out of 11 forms 6 were further subdivided into two groups, spikes with yellow and those with purple colored seeds. Accordingly, this sample was classified into 17 types by spike characteristics and seed color.

Spikes with purple seed which are endemic to Ethiopia were found both in *T. durum* and *T. turgidum*. As shown in Table 6, in many market collections of wheat purple seeds were found admixed with yellow seeds in varying degree from 0.2 to 92.2 per cent.

The Ethiopian farmers usually harvest those variable wheats as a whole and the following year they broadcast seeds as a mixture of various forms in their fields. Judging from the patterns of variation and culture practice of farmers, it is assumed that the abundance of polymorphic variation observed in *T. durum* and *T. turgidum* in the fields has been maintained year after year.

T. polonicum was found only in a field growing sporadically with *T. durum* and *T. turgidum*. This particular emmer wheat seems to be disappearing from Ethiopian wheat fields. Ciferri (1961) mentioned that this species in Ethiopia is of no economic value.

T. dicoccum is one of the most primitive cultivated forms of emmer wheat. This species is usually cultivated in pure stand isolated from other wheats. It is called "*aja*" in Amharic, while, other species of wheat are called collectively as "*sinde*". Two samples of *T. dicoccum* were sold not as threshed seeds but as spikelets. According to a local farmer, people harvest spikes of this species in the early morning from the field while they are still wet by dew because of considerable brittleness of ripe spikes. The spike color variation of this species was relatively small compared with that of *T. durum* or *T. turgidum*.

2. Barley

Vavilov (1926, 1928) considered that Ethiopia is one of two principal centers of the diversity of cultivated barleys, especially in forms of hulled barley. Orlov (1929) classified Vavilov's collections into 38 varieties. Out of them, 19 have been regarded as endemic to Ethiopia. Ciferri (1944) listed 60 varieties of barley in Ethiopia and suggested that further explorations would increase the number of varieties. Similar studies of Ethiopian barleys collected in 1937–1938 by Troll and Schottenloher were made by Giessen *et al.* (1956). From 1,645 samples of barley they found 68 varieties including 170 types. Takahashi (1955) pointed out that out of 23 systematically and agronomically important characters of barley, 14 were found in Ethiopia. Our present collections of barley also indicate morphological diversity of this crop. Out of 207 field samples, about half (53.1%) were two row-*deficiens* and *irregulare-deficiens* which are endemic to Ethiopia. Six row barley was 40% of the samples.

Market collections of barley also indicate that highly polymorphic forms are cultivated by the local farmers and consequently sold at the local markets as a mixture of various forms. Most market samples were hulled but only two samples of naked barley were collected at Agaro showing also a conspicuous mixture of different seed colors.

3. Weeds associated with wheat and barley

During the expedition it was noticed that two wild species of Gramineae, *Lolium temulentum* and *Avena vaviloviana* (a wild form of cultivated *Avena abyssinica*) were frequently found with the wheat and barley in cultivated fields. This association was acertained by the analysis of field random samplings of wheat and barley. Among 16 random samples *Lolium* was found in 4 samples and *Avena* in a sample. For example, in a random sample of wheat (collection no. 1-23-(2)-1) collected at 65 km from Addis Ababa to Fiche, 20 spikes (2.8%) of *Lolium* in 143 spikes were found and 7 were awned and the remaining 13 were awnless. In a barley random sample made at 60 km from Debre Berhan to Debre Sina, 6 spikes of *Avena* (4.2% in 143 spikes) were observed. Furthermore, the relationship between wheat or barley and *Lolium* or *Avena* became conspicuous after the examination of market collections of wheat and barley. As shown in Tables 6 and 9, seeds of *Lolium* and *Avena* were frequently mixed with the seeds of these two crops. Out of 45 wheat samples, 43 (95.6%) contained *Lolium* and *Avena* seeds were found in 15 (33.3%) samples. On the other hand, of 40 samples of barley, 26 (65.0%) contained *Lolium* and 29 (72.5%) were accompanied with *Avena* seeds. Frequency distribution of mixing rate of these two weed seeds in wheat or barley samples are shown in Table 25. A lower degree of *Avena* with wheat seems to be mainly due to earlier ripening of *Avena* in the wheat fields. Vavilov (1928) noticed a close relationship between *Avena* and wheat or barley in Ethiopia. Although no extensive studies of the present market samples have been made yet, analysis of the crop-weed complex might be very important in considering the origin and history of ecological association between cultivated plants and their weeds.

In several market samples, a mixture of yellow and black glumes of *Lolium* and *Avena* was found. For example, a market collection (collection no. 1-25-23) of wheat collected

Table 25. Frequency distribution of the mixing rate of *Lolium* and *Avena* in wheat and barley market samples (Data based on Tables 6 and 9.)

Mixing rate (%)	No. of wheat samples with:		No. of barley samples with:	
	Lolium	*Avena*	*Lolium*	*Avena*
0	2	30	15	11
0.1–2.0	10	14	8	15
2.1–4.0	6	1	4	7
4.1–6.0	9	—	2	2
6.1–8.0	8	—	5	1
8.1–10.0	2	—	2	—
10.1–12.0	4	—	—	1
12.1–14.0	1	—	—	1
12.1–14.0	1	—	—	1
14.1–16.0	3	—	1	—
16.1–18.0	—	—	1	1
18.1–20.0	—	—	1	—
20.1–22.0	—	—	—	—
22.1–24.0	—	—	1	1
total	45	45	40	40

at Amsit contained *Lolium* seeds with yellow and black glumes, while, in a sample (2-3-8) of barley obtained at Makale *Avena* seeds with yellow as well as black glumes were found (Fig. 21). In the latter sample coloration of black glumes between barley and *Avena* was indistinguishable. A kind of mimicry of weed species to their closely associated cultivated plants is quite an interesting phenomenon.

4. Teff

Teff is one of the specific indigenous cultivated plants which is grown widely over the highland of Ethiopia. According to Ethiopian Statistical Abstracts (1966), the area of teff cultivation is about half of the total field of cereals. Teff is used for "*injera*" (a kind of fermented bread) which is a unique staple food of the Amhara and some other tribes in Ethiopia. White teff seeds are prefered for making "*injera*". During our expedition we noticed that the market price of white seeds was higher than that of red teff.

The evolution center of the genus *Eragrostis* to which teff belongs is in Africa (Ciferri and Baldrati, 1961). Although the precise place of its origin is not known, Vavilov (1951) listed teff as one of the cultivated plants which originated in Ethiopia. Generally teff is classified into two categories based on seed color, white seeded and red seeded. The former is extremely variable with respect to plant size, glume color and time of maturity, on the contrary, the latter is rather uniform (Rouk and Mengesha, 1963). Ciferri and Baldrati (1961) classified teff into 13 varieties.

Judging from the present collections of teff, this crop is very variable.

5. Sorghum, finger millet and maize

Vavilov (1951) noted sorghum as one of the cultivated plants which originated in Ethiopia. According to Damon (1962), it seems most probable that in places like the

Ethiopian highlands, man first harvested sorghum for use in building his primitive shelters and for grain, and later he learned to sow and cultivate sorghum. Comparative morphological studies by De Wet and Huckabay (1967) indicated that sorghum was probably enobled independently in at least three African regions, from three morphologically different prototypes.

In Ethiopia sorghum is used for various purposes: food, malts, feed, fuel and house building materials. Thus, sorghum is an important crop next to teff in the central part of this country. The cultivation area of this crop is estimated at 1384,000 ha. in 1964 (Ethiopia Statistical Abstracts, 1966). Damon (1962) collected many samplse of sorghum in Ethiopia and classified them into six species with 15 varieties. The present field as well as market collections indicate an abundance of various forms which are cultivated as the mixed stands. Particularly a quite wide range of seed color variations in each market sample became apparent.

Finger millet is an annual grass crop belonging to the genus *Eleusine*. Ciferri (1961) noticed two groups of finger millet in Ethiopia, one with a short spike and denser spikelets and the other with a longer but lax spikes. He classified these two groups into three respective varieties based on red, black and white seed color. In the present market collections of finger millet all variations were obtained. This crop is mainly used for the main material of the local beer, "*t'ela*".

It is estimated that maize was widely grown in Ethiopia already in the latter half of the 16th century (Miracle 1965). Two varieties, flint and dent, have been cultivated in Ethiopia (Huffnagel 1961). The most common form found in our collections was flint corn type with white, white-yellow or yellow albumen color. Seeds with coloration in aleurone layer were observed infrequently in many samples.

6. Legumes

Govorov (1930) considered Ethiopia as the primary center where the forms of cultivated field pea have originated. This was based on a whole series of dominant characters distinctive of all the material investigated, on the complexity of some of the characters and on the endemism of separate forms. His view was also supported by the analysis of seed color variations in the present collections of field pea. Seeds with brown hilm and angular shape with single color and mottled, were the most familiar in the present market collections. However, those with black hilm were only sporadically observed.

Chick pea is widely grown in Ethiopia. It is often used for making an Ethiopian sauce called "*wat*". Vavilov (1928) mentioned that chick pea in Ethiopia is characterized by very many colored forms compared with those collected from Mediterranean regions and Turkestan. Vavilov's view was clearly supported by the present collections as shown in Table 18. The forms with white-yellow, light brown, brown seed coloration were the most common in Ethiopia. Black colored seeds which are very specific in this country were also considerably common.

Two varieties of lentil were recognized in Ethiopia by Barulina (1930). They are var. *abyssinica* having brown dotted seeds and var. *coptica* with black seeds. Judging from the

market samples of lentil (Table 19), brown or dark-brown seeds with black dots, i.e., var. *abyssinica,* are the most commonly cultivated form. Black seeds, var. *coptica,* are also widely grown together with the former variety in Ethiopia.

Vavilov (1951) mentioned that Ethiopia is probably a secondary center of horse bean. According to Huffnagel (1962), a small type of horse bean is widely grown in Ethiopia. However, 100 seed weight of the present market collections of horse bean (Table 20) was variable from sample to sample. A small type as well as a large type is cultivated in Ethiopia. Considerable variations of seed color were demonstrated from the analysis of the samples collected. The results seems to support Vavilov's view.

Vigna unguiculata L. and *V. sinensis* L. are regarded as native species of Africa (Stanton 1966). On the other hand, Vavilov (1951) described Ethiopia as a primary center of *V. sinensis* Endl. var. *sinensis* (Stick.) Pip. and *V. sinensis* Endl. var. *cajan* (Walp.) Pip. Taxonomical studies of the present complex samples of *Vigna* are necessary to clarify the botanical situation of this genus in Ethiopia.

Although Vavilov (1951) did not mention *Phaseolus* in Ethiopia, different cultivated forms probably including several species were collected at 13 local markets along the expedition routes. Further studies are needed to recognize whether Ethiopia is a diversity center of several cultivated species of *Phaseolus* or not. *Phaseolus mungo* was merely collected at a small shop along an alley of Awash Station.

Vavilov (1951) noted Ethiopia as a variation center of grass pea. The present preliminary observation of this legume supports his view.

Further studies on the present collections of several cultivated cereals are now in progress by the following specialists in Japan:

Field collections of wheat: Dr. M. Tanaka, Faculty of Agriculture, Kyoto University

Field collections of barley: Dr. R. Takahashi, The Ohara Institute for Agricultural Biology, Okayama University

Collections of sorghum: Dr. S. Taniguchi, Faculty of Agriculture, Ibaragi University

Collections of teff: Dr. T. Yabuno, Faculty of Agriculture, Osaka Prefectural University and Dr. K. Hoshikawa, Faculty of Agriculture, University of Tokyo

CONCLUSION AND SUMMARY

1. Observations and collections of various cultivated plants in Ethiopia were carried out, from December, 1967 to March, 1968, by the Botany Team of the Kyoto University Scientific Expedition to the Sahara and the Surrounding Areas.

2. About 1,000 samples from the field and 750 samples from 21 local markets were collected during the expedition. Several random samplings from the fields were also made.

3. Preliminary observation and analysis of variations found in the collected samples of the following cereals and legumes were carried out.

cereals: wheat, barley, teff, sorghum, finger millet and maize

legumes: field pea, chick pea, horse bean, lentil, *Vigna*, *Phaseolus* and grass pea

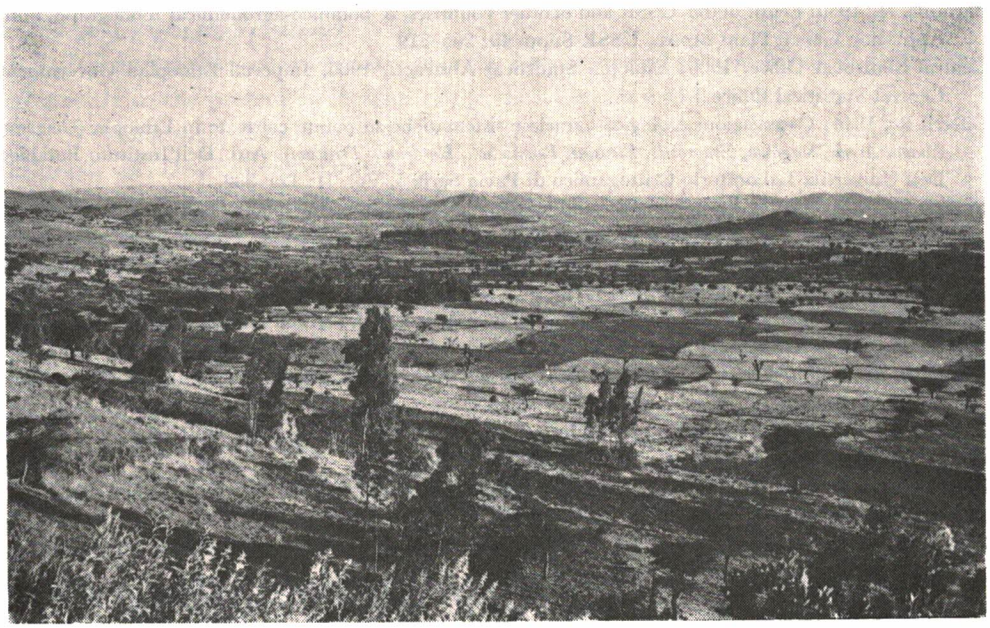


Fig. 2. View from the foot of Mt. Erer, east of Debre Zeit, Shoa Province (Central Ethiopia).

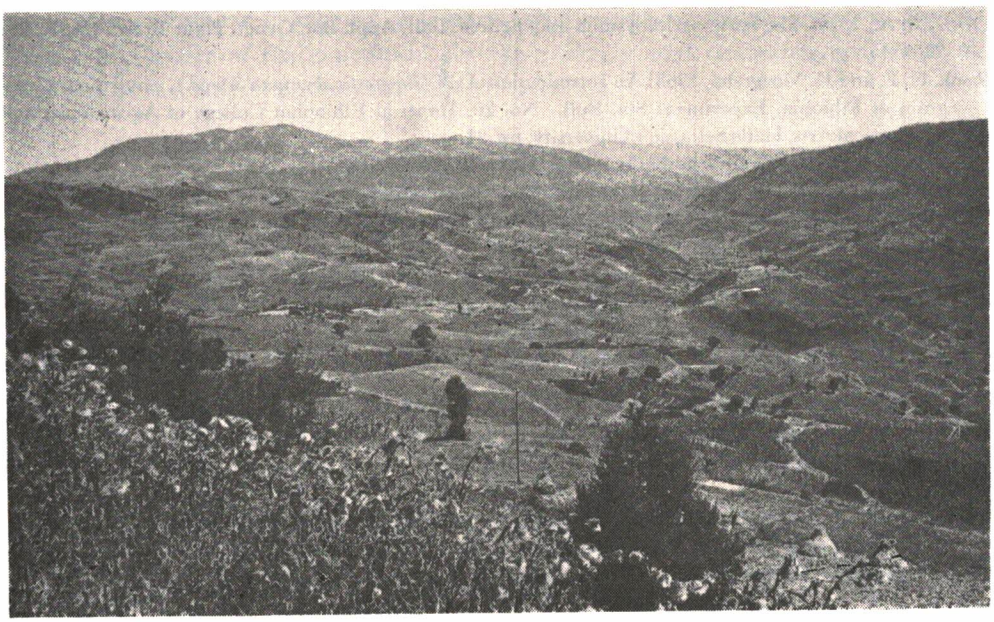


Fig. 3. Chercher Highland, Harrar Province (Eastern Ethiopia).

Fig. 4. View from a mountain pass, north of Maichew, Tigre Province (Northern Ethiopia)

Fig. 7. Harvesting of barley near Molale, Shoa Province.

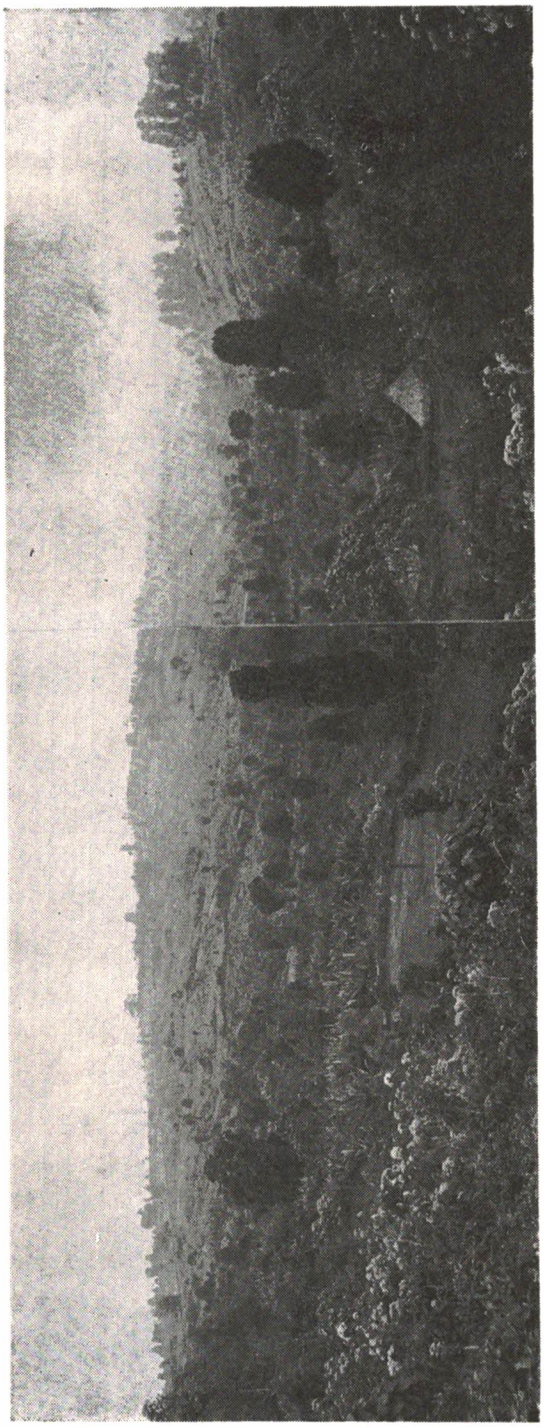


Fig. 5. View from a hill near Agere Salam, Sidamo Province (Southern Ethiopia).

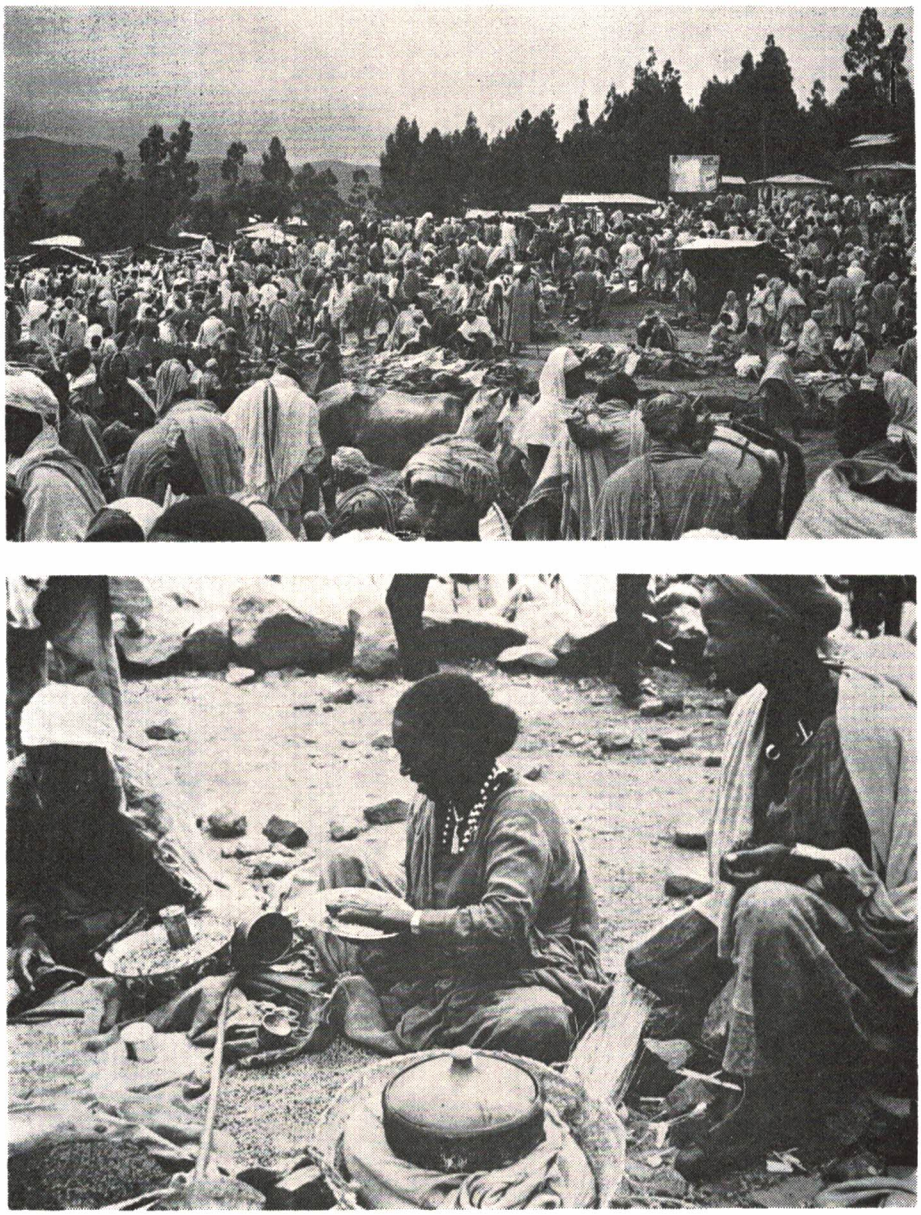


Fig. 6. Local market at Dessie, Wollo Province.

Fig. 8. Harvesting of teff near Ghion, Shoa Province.

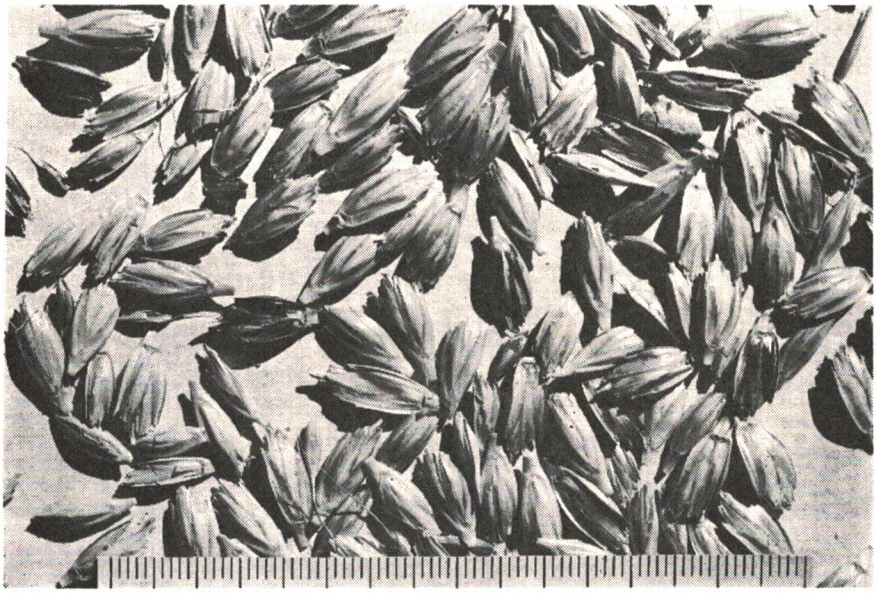


Fig. 10. A market sample of *Triticum dicoccum* (collection no. 12-27-4).

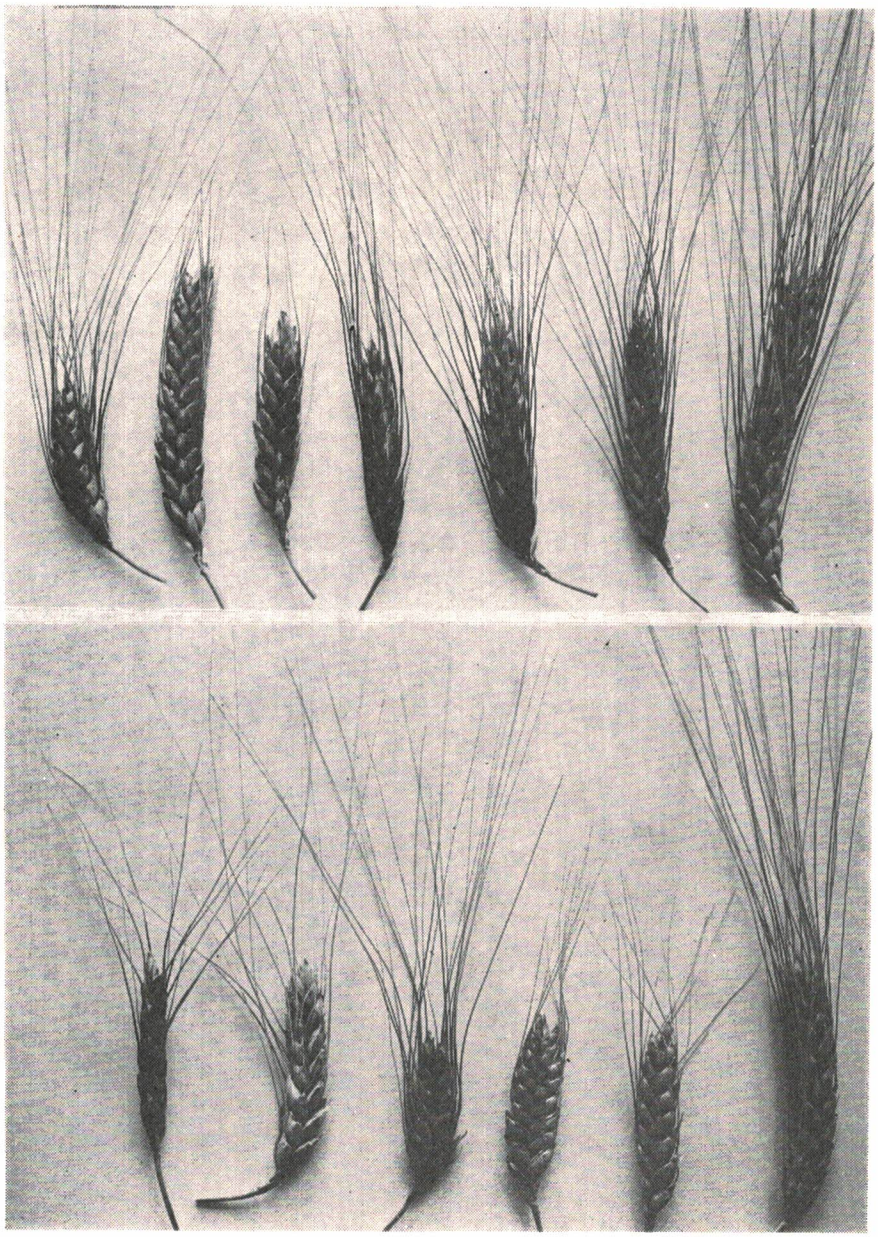


Fig. 9. Spikes of a wheat random sampling (conllection no. 2-23-(3)).

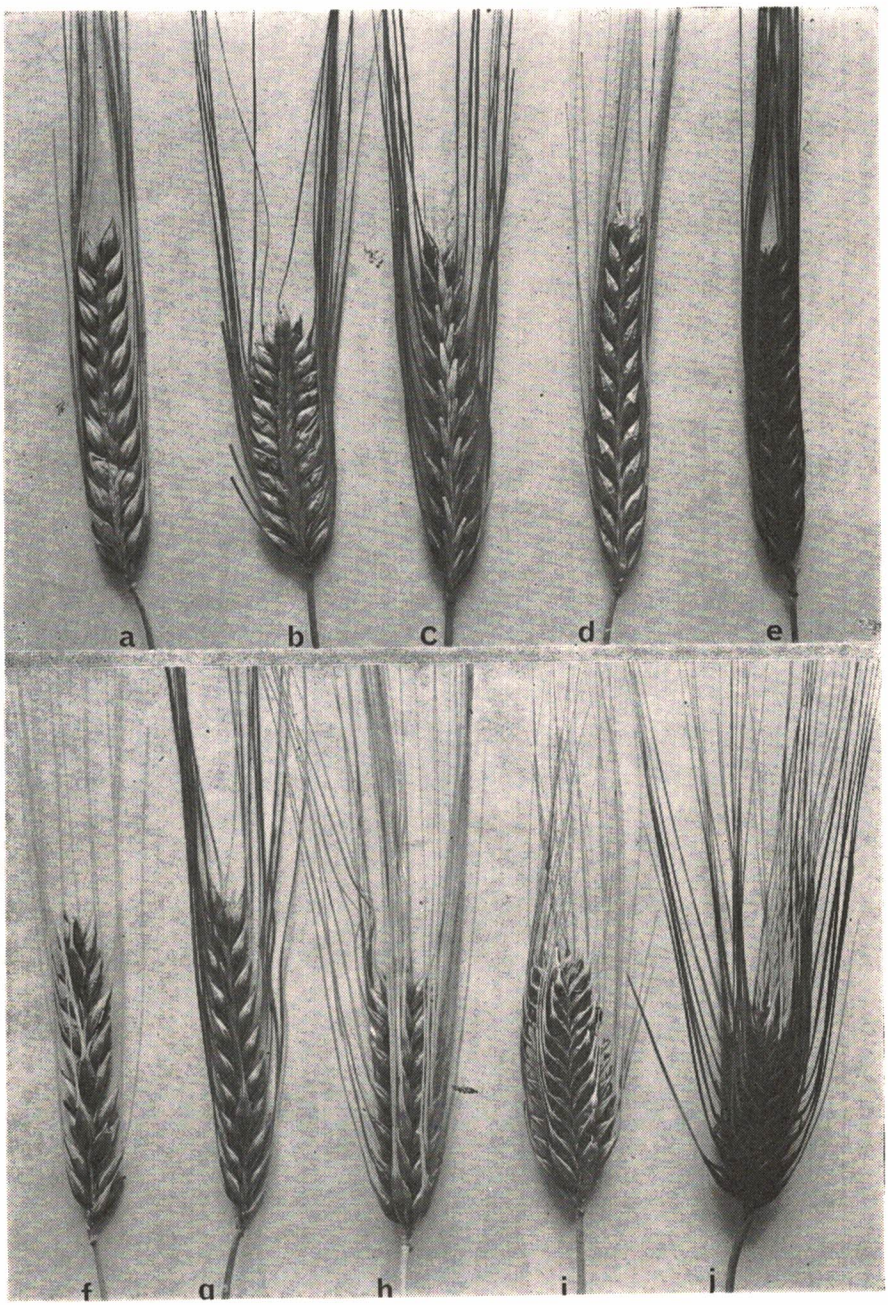


Fig. 11. Spikes of barley from field collections.
a-c: two row barley
d-e: two row-*deficiens* barley
f-g: *irregulare-deficiens* barley
h-j: six row barley

Fig. 12. A market sample of barley (collection no. 2-3-8).

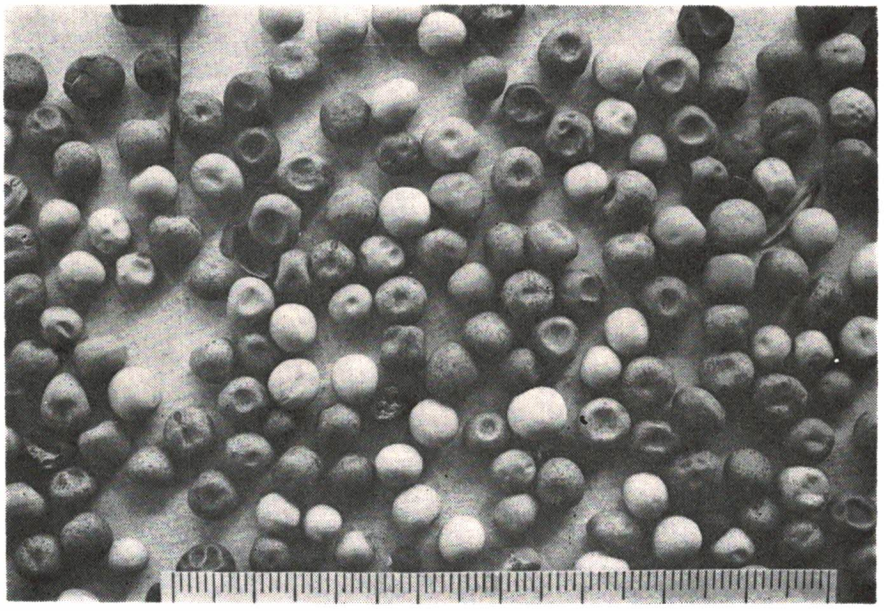


Fig. 16. A market sample of field pea (collection no. 12-27-20).

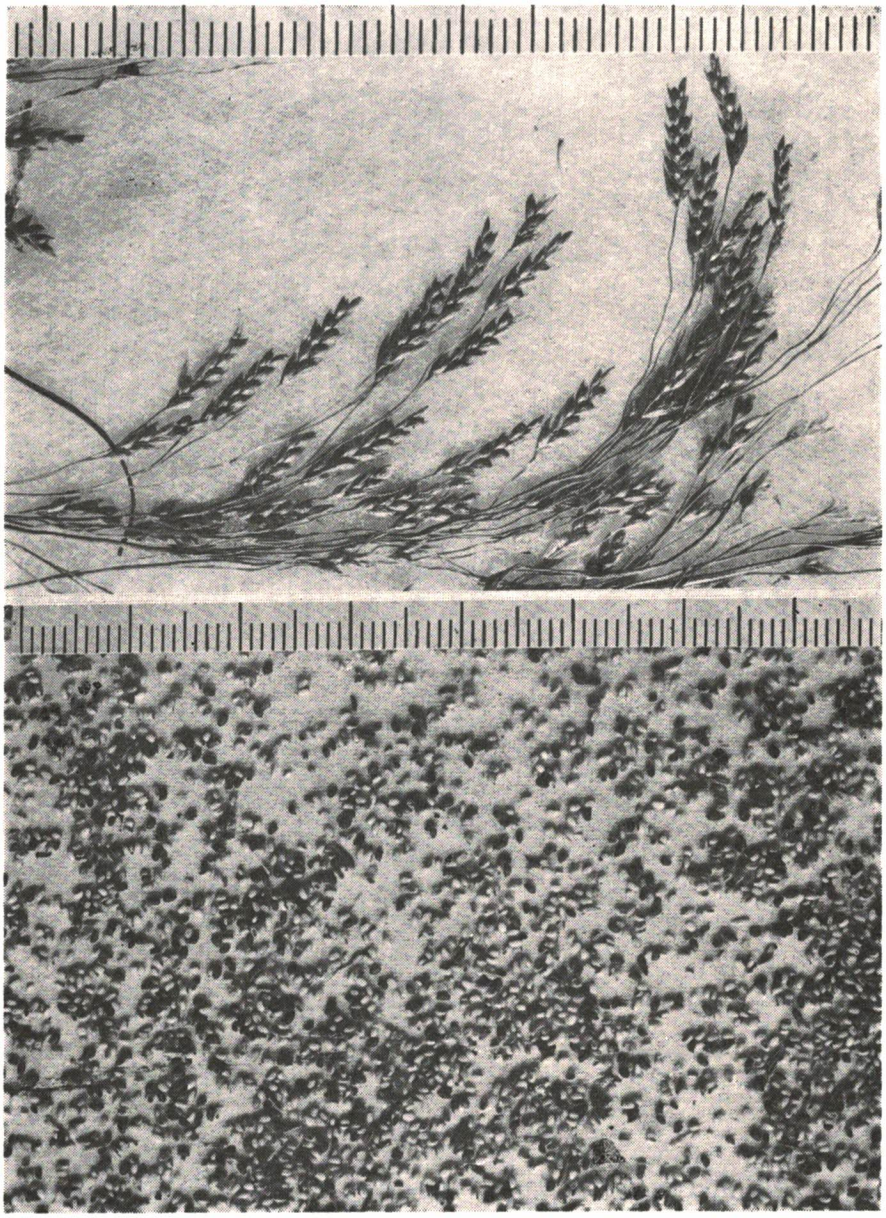


Fig. 13. Spikes and seeds of teff.
a. A collection at 80 km from Addis Ababa to Ghion (2190m alt.), Shoa Province.
b. A market collection (collection no. 12-27-10).

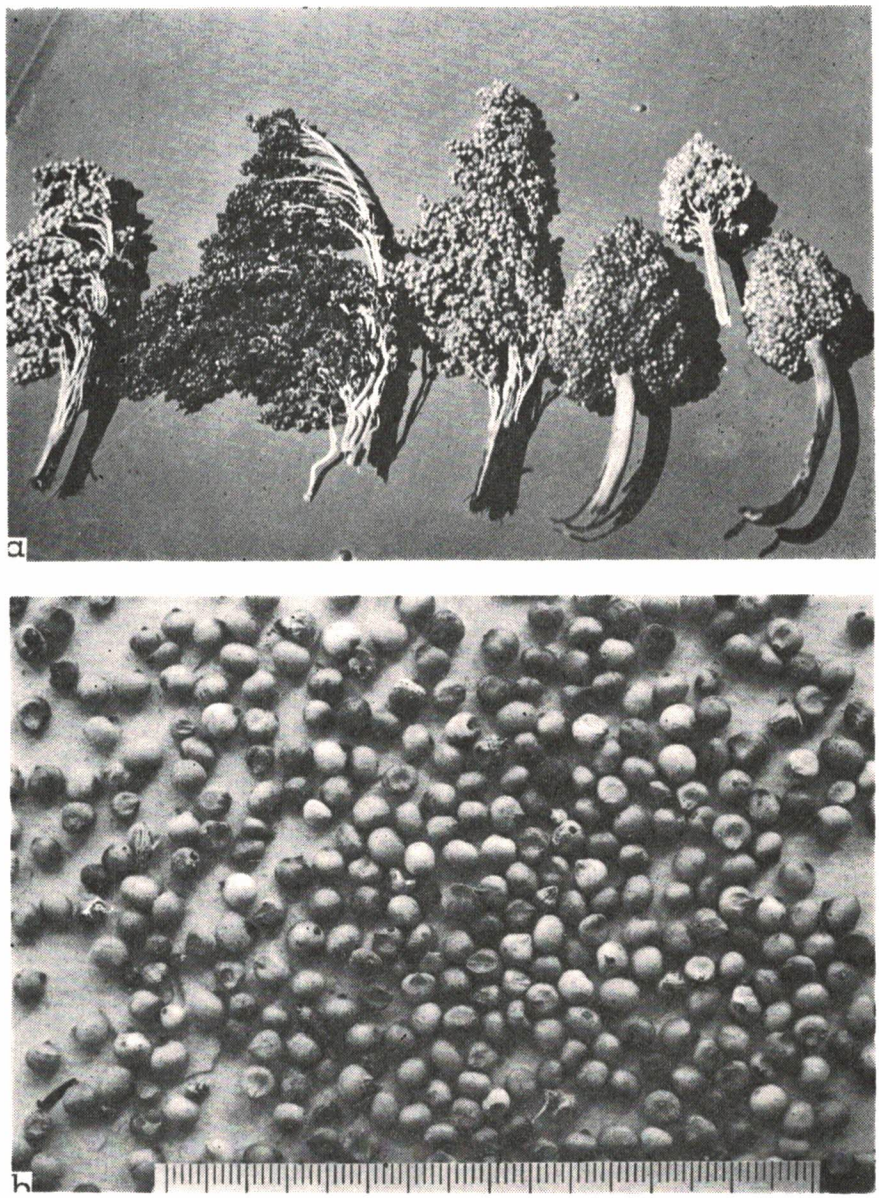


Fig. 14. Spikes and seeds of sorghum.
a. Collections from a field at 3km from Asbe Tafari to Alemaya (1800m alt.), Harrar Province.
b. A market sample (collection no. 2-10-7).

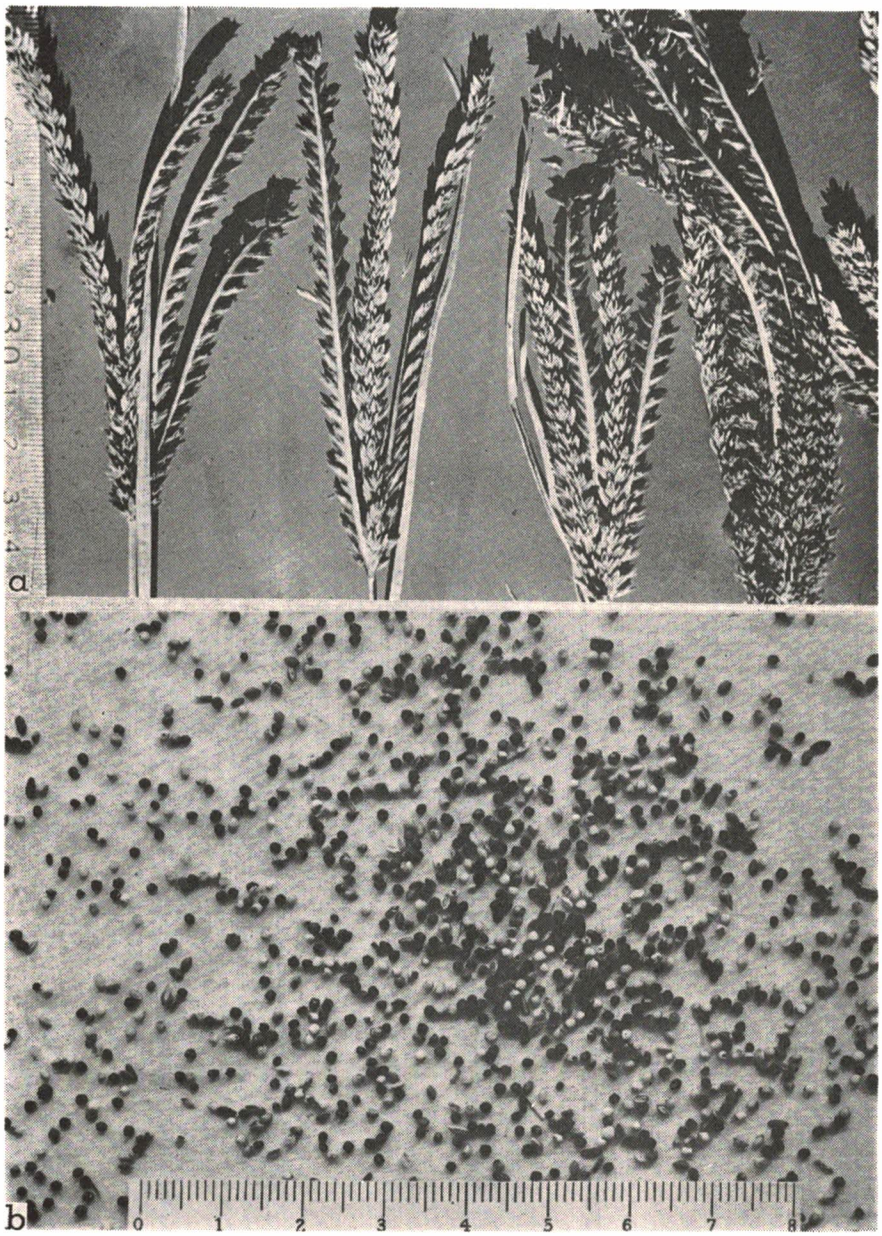


Fig. 15. Spikes and seeds of finger millet.
a. Collections from a field at 25 km from Bahar Dar to Gondar (1920 m alt.), Begemder Province.
b. A market sample (collection no. 2-20-11)

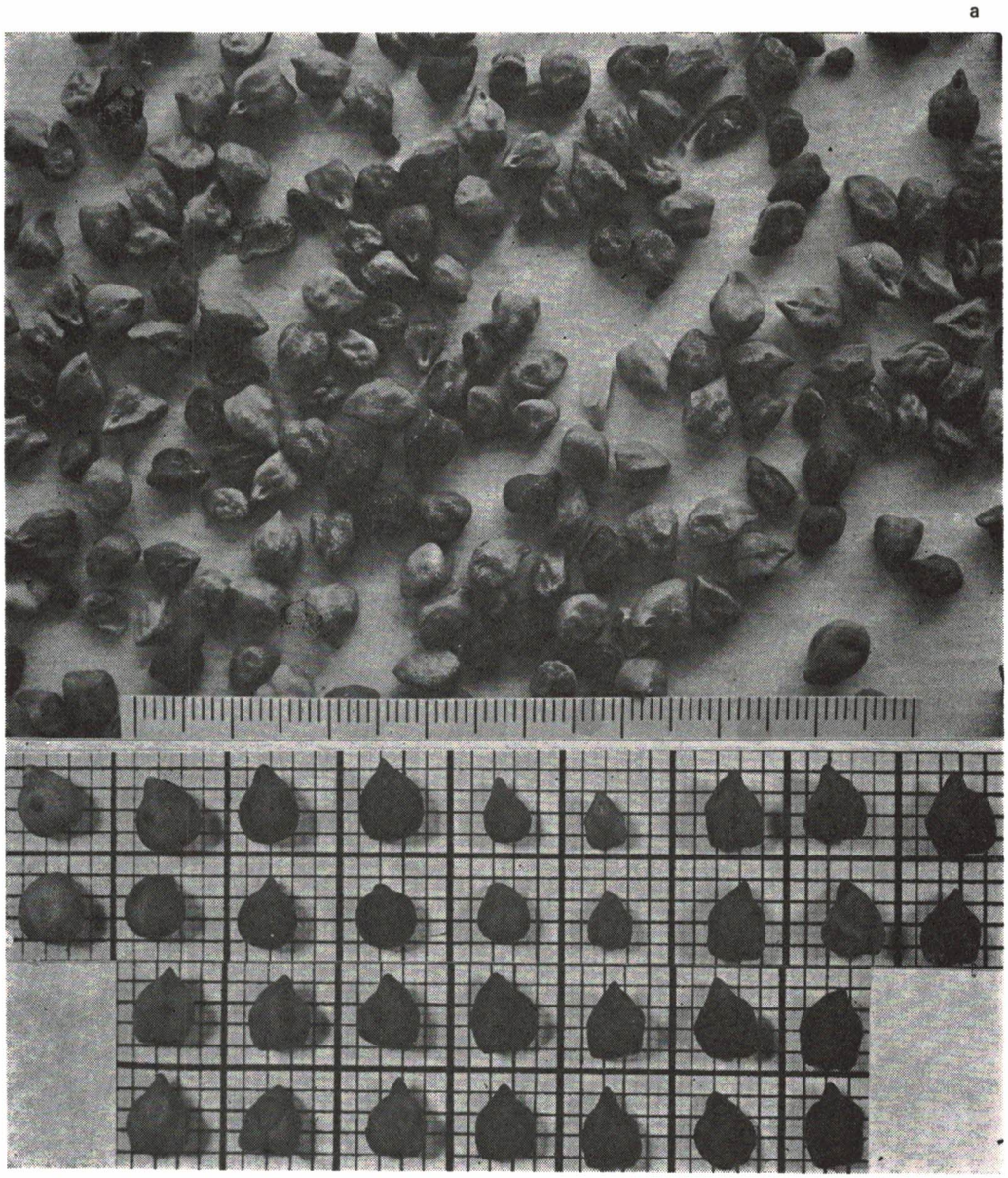


Fig. 17. Seeds of chick pea.
a. A market sample (collection no. 2-3-18).
b. Various types of seeds from market collecttions.

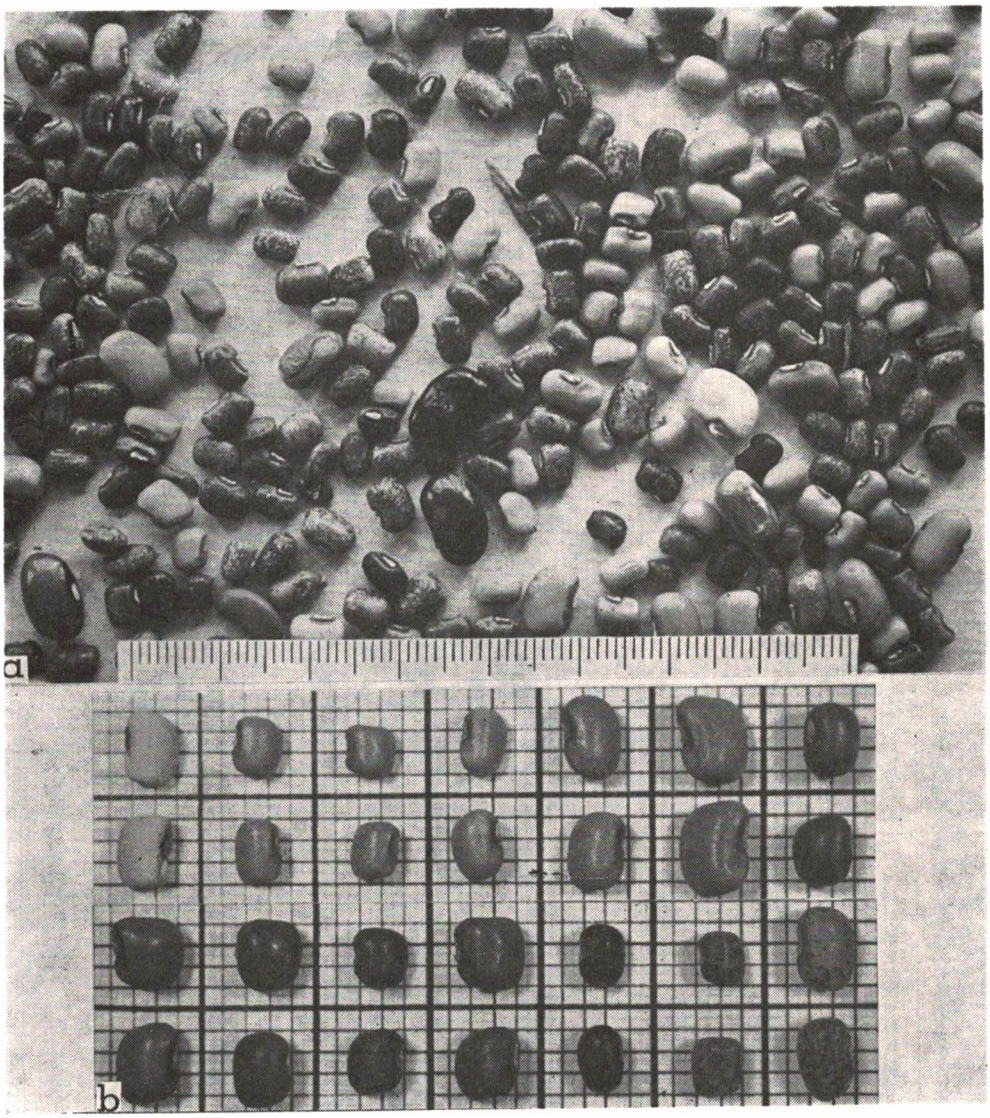


Fig. 18. Seeds of *Vigna* spp.
a. A market sample (collection no. 1-14-78).
b. Various types of seeds from market collections.

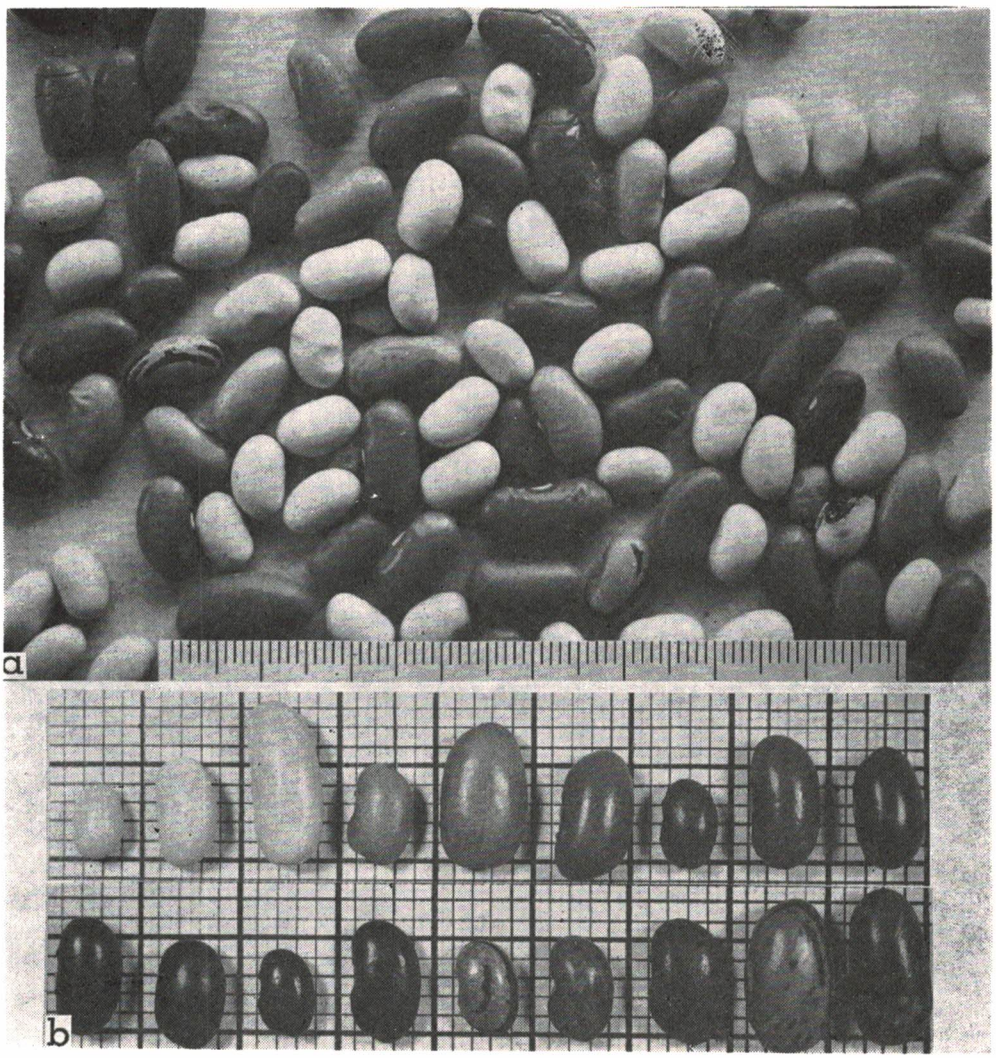


Fig. 19. Seeds of *Phaseolus* spp.
a. A market sample (collection no. 1-13-41).
b. Various types of seeds from market collections.

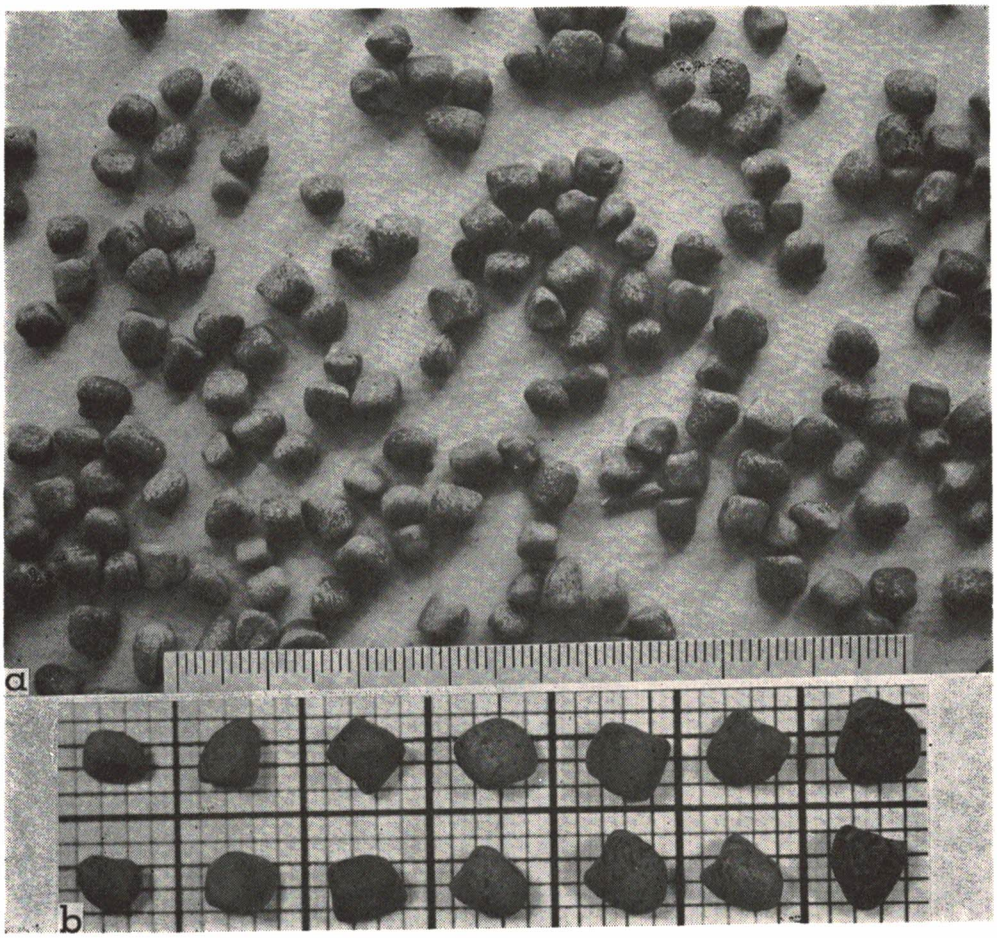


Fig. 20. Seeds of grass pea.
a. A market sample (collection no. 2-3-27).
b. Various types of seeds from market collections.

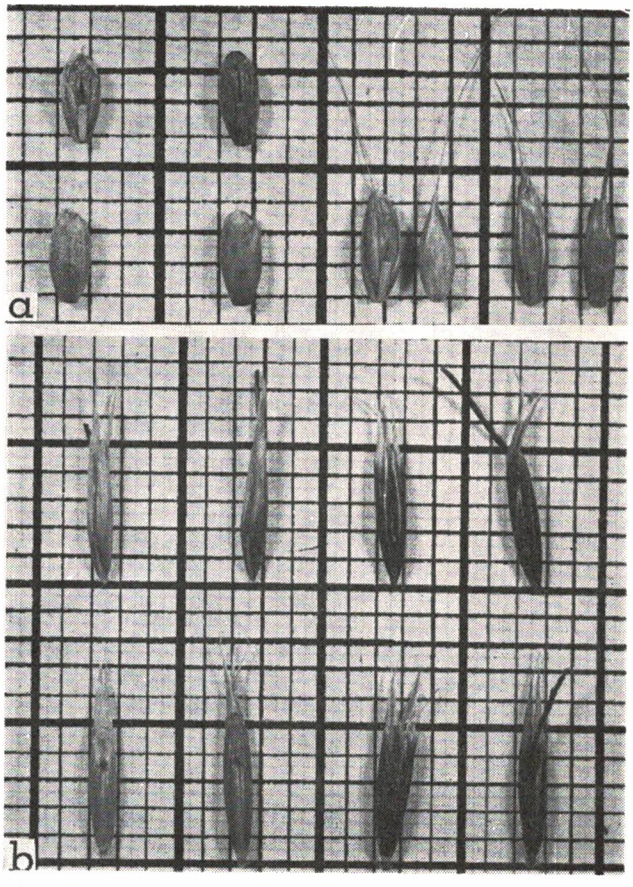


Fig. 21. *Lolium* and *Avena* seeds in wheat and barley market collections.
a. *Lolium temulentum*
b. *Avena vaviloviana*