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Germplasm Collection of Alfalfa (*Medicago Sativa L.*) in Oman

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Abstract **– Alfalfa (*Medicago sativa* L.) is a very important leguminous perennial fodder crop in the Sultanate of Oman, the neighboring gulf, and other countries where it is regarded as part of farm life. The paper presents the salient results of series of alfalfa germplasm collection missions across all the governorates of Oman. It also includes the pattern of variations in seed characters existing in as many as 67 alfalfa accessions, collected. Of these, the highest number of accessions were from Eastern / Al-Sharqiyah governorates (25) followed by 20 from Interior/ Al-Dakhliyah governorate, 8 each from North Batinah and Dhahira & Buraimi governorates, 6 from South Batinah governorate and none from Dhofar governorate in the south part of Oman. The seed accessions showed wide variations in respect to all seed characters studied, i.e. seed length (cm) and width (cm), 1000-seed weight (g) and seed nature & color. All the accessions were heterogeneous (mixture) having seeds of various colors, i.e. tan, greenish yellow, dark yellow, brown, dark brown. The diversity of alfalfa seed accessions with respect to seed characteristics and their genetic erosion have been discussed in relation to geographic diversity and socio-cultural factors.**

Keywords **– Landraces, Accession, Seed Characters, Diversity, Alfalfa.**

I. INTRODUCTION

The Sultanate of Oman is the second largest country in the Arabian Peninsula with 85473.10 ha of agricultural land under cultivation [1]. Fruits occupy 36.11% followed by perennial and annual fodder crops (39.40%), vegetables (19.72%) and field crops (4.77%). Fodder demand is mostly met with local production of alfalfa, Rhodes grass and some annual forage cereals and legumes. Alfalfa (*Medicago sativa* L.) is grown by every farmer in the Sultanate at least on small piece of land depending on the size of holding to feed his goats, sheep, cattle or camels. Alfalfa is grown on about 9313.45 ha, i.e. 8.25% of the cultivated area or 27.65% of the area sown to fodder crops [1]. This is common throughout the Arabian Peninsula with alfalfa grown widely in Al-Batinah, Salalah plains, Interior and the desert plains of Nejd in Oman. Planting of alfalfa is usually done between November and January with the first crop cut after 60–70 days and then every 25–40 days for up to 10–11 times per year. The typical yield of green matter is 40 t/ha/year.

Over time, different agro-ecotypes of alfalfa have been recognized, mainly on the basis of longevity. The variants of *Batini* type have an expected lifespan of 8–10 years in the Batinah but they underperform when grown in the mountains. There are local strains in the Hajar mountains known to persist for more than ten years, but they fail when grown on the coast, where *Quryati* is popular. There are also distinct types grown in different governorates like *Sharqiyi* around Sharqiya and *Dakhliyi* in the Interior governorate. In contrast, all local cultivars are grown as an annual on the Salalah plains, as it succumbs to crown rust in the *Kharif.* The strains in the south are distinct from those in the north. Exotic cultivars are not usually grown as farmers do not believe they are suitable for hand cutting. More recently, farmers have encountered several problems with alfalfa cultivation related to abiotic factors such as water scarcity, soil and water salinity; biotic factors such as witches-broom disease; and management factors concerning cutting methods. Local alfalfa cultivars are not amenable to mechanization as it is found to affect both yield and persistence [2, 3].

Due to varied ecological conditions, a range of indigenous varieties of different field crops are grown in Oman, which is preferred by farmers for their productivity, quality and affinity. However, due to changing land use patterns and the gradual introduction of high-yielding varieties, the local indigenous germplasm of various crop species has been slowly disappearing. In the past four decades, several missions were conducted to collect germplasm of crops grown in Oman. First collections were undertaken jointly with the International Bureau of Plant Genetic Resources in 1980, 1987 and 1988 [4]. Since 1996, several missions have been undertaken by the Ministry of Agriculture & Fisheries in collaboration with regional and international organizations [5, 6, 7, 8], and by the Sultan Qaboos University and the Royal Gardens. During these missions, alfalfa, wheat, cucumber and grain legume landraces were collected and placed in local conservation facilities. Local germplasm accessions in crops like alfalfa (83 accessions), wheat (100 accessions), barley (20 accessions), chickpea (20 accessions), fenugreek (9 accessions), coriander (5 accessions) and broad bean (3 accessions) were collected by the joint mission of Ministry of Agriculture & Fisheries and

IBPGR (presently, IPGRI or Bioversity International) [4]. All these accessions have been conserved in the ICARDA gene bank. More than 600 collected accessions from about 270 species including food and fodder crops are conserved by international centers such as ICARDA and national institutes such as USDA. In continuation of the above collections, a series of joint collection missions between the Sultan Qaboos University and the Ministry of Agriculture & Fisheries from April 2008 to October 2009 was undertaken to explore genetic diversity by collecting indigenous germplasm of alfalfa from different sites within different governorates of Oman.

II. Materials and Methods

Materials and methods adopted for collecting legume germplasm and conservation were described in 2014 by Al-Saady *et al.* [9]. Indigenous alfalfa accessions were collected from 62 sites (Table 1 and Fig.1). Seed characters such as seed length and width (cm), test weight (1000 seed), seed color and nature of seed samples (pure or mixture) were determined in the laboratory [10].

Table 1. Governorates, wilayats and villages along with latitude (N), longitude (E), Northing, Easting and altitude of each collecting site of indigenous alfalfa accessions

No.	Site No.	Governorate	Wilayat	Village	Latitude (N)	Longitude (E)	Northing	Easting	Altitude (meters above msl)
1	1	Interior	Nizwa	Tanouf	23° 02.00'	57° 43.45'	2547427	574200	604
2	3	Interior	Nizwa	Nizwa city	22° 57.80'	57° 31.67'	2539591	554111	508
3	10	Interior	Adam	Alsmeerat	22° 22.38'	57° 31.95'	2474243	554823	278
4	11	Interior	Adam	Al Belad	22° 22.65'	57° 31.70'	2474739	554392	308
5	14	Interior	Bahla	Alfeth Old village	22° 55.27'	57° 18.51'	2534859	531635	555
6	15	Interior	Bahla	Tawee A Nuseif	22° 57.66'	57° 12.63'	2539251	521579	583
7	20	Interior	Al Hamra	Ghamour	23° 05.02'	57° 16.45'	2552841	528081	663
8	21b	Interior	Bahla	Bilad Sait	23° 01.88'	57° 15.93'	2547046	527204	605
9	29	Dhahira	Ibri	Bat	23° 15.22'	56° 45.23'	2571656	474819	508
10	30	Dhahira	Ibri	Al-Ablaah	23° 04.84'	56° 54.14'	2552486	489997	580
11	31	Dhahira	Ibri	Baroot	23° 14.55'	57° 02.47'	2570399	504211	716
12	32	Interior	Bahla	Sint	23° 07.96'	57° 04.64'	2558242	507918	952
13	37	Dhahira	Yanqul	Al-Bouwerdah	23° 38.06'	56° 29.76'	2613868	448591	586
*14	42	Batinah South	Rustaq	Amq	-	-	-	-	-
15	45	Batinah South	Rustaq	Azammah	23° 13.48'	57° 24.79'	2568484	542274	614
16	51	Batinah South	Rustaq	Al Ghasahb	23° 24.97'	57° 25.92'	2589691	544137	274
17	56	Batinah South	Rustaq	Atayeeb	23° 25.40'	57° 09.78'	2590427	516653	557
18	57	Batinah South	Rustaq	Almahdooth	23° 30.52'	57° 11.42'	2599878	519433	482
19	65	Batihah South	Nakhal	Alqoorah	23° 05.38'	57° 44.20'	2553670	575449	1322
*20	72	Batinah South	Rustaq	Mori wadi bani Ghafer	-	-	-	-	-
21	74	Interior	Bid'bid	Al-Rujh	23° 33.40'	57° 21.52'	2605225	536606	277
22	75	Interior	Bid'bid	Nidab	23° 12.78'	58° 8.02'	2567585	616007	454
23	76	Interior	Bid'bid	Lizzak	23° 18.75'	58° 06.01'	2578575	612495	287
24	77	Interior	Bid'bid	Al-Hazam	23° 19.20'	58° 07.01'	2579419	614193	401
25	78	Interior	Sumail	Tawi Dahman	23° 18.11'	58° 22.22'	2577630	640135	305
26	80	Interior	Sumail	Al-Ayanah	23° 02.59'	57° 57.68'	2548655	598495	736
27	81	Interior	Izki	Imty	23° 0.58'	57° 47.01'	2545735	682791	585
28	82	Interior	Izki	Zukait	22° 21.43'	57° 44.24'	2472579	575921	466
29	84	Interior	Izki	Al-Aqil	22° 47.01'	57° 51.23'	2519839	587647	432
30	85	Buraimi	Buraimi	Hamasah	24° 14.78'	55° 46.14'	2682087	375022	269
*31	88	Buraimi	Buraimi	Al- Hail	-	-	-	-	-
*32	90	Buraimi	Buraimi	Al- Raabi	-	-	-	-	-
33	91	Buraimi	Mahdah	Mukteebyyah	24° 54.35'	55° 50.55'	2755055	383098	421
34	96	Sharqiya	Al-Qabel	Bateen	22° 45.42'	58° 41.40'	2517643	673527	442
35	97	Sharqiya	Al-Qabel	Bateen	22° 39.25'	58° 41.13'	2506251	673194	442
36	98	Sharqiya	Al-Qabel	Al-Neba	22° 43.72'	58° 41.01'	2514498	672895	411
37	99	Sharqiya	Al-Qabel	Al-Dubaha	22° 35.89'	58° 10.97'	2499553	621586	625
38	100	Sharqiya	Wadi Bani Khalid	Al-Raaki	22° 36.13'	59° 04.48'	2500998	713275	857
39	101	Sharqiya	Wadi Bani Khalid	Al-Raaki	22° 36.13'	59° 04.48'	2500998	713275	835
40	102	Sharqiya	Ibra	AL-Yahmadi	22° 46.59'	58° 31.24'	2519614	656115	49
41	104	Sharqiya	Ibra	AL-Hiamah	22° 48.76'	56° 25.93'	2522927	441724	500
42	105	Sharqiya	Ibra	AL-Hiamah	22° 49.97'	58° 25.72'	2525757	646608	521
43	106	Sharqiya	Ibra	Al-Khoodood	22° 52.02'	58° 25.93'	2529544	646931	565
44	107	Sharqiya	Mudhaibi	Al-Rawadah	22° 53.10'	58° 13.12'	2531340	625008	610
45	109	Sharqiya	Mudhaibi	Al-Rawadah	22° 53.05'	58° 13.25'	2531249	625231	617
46	110	Sharqiya	Mudhaibi	Wadi endam	22° 52.71'	58° 00.31'	2530455	603111	576

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No.	Site No.	Governorate	Wilayat	Village	Latitude (N)	Longitude (E)	Northing	Easting	Altitude (meters above msl)
47	111	Sharqiya	Mudhaibi	Al-Kreesheefah	22° 16.75'	58° 02.70'	2464131	607662	245
48	112	Sharqiya	Mudhaibi	Al-Kreesheefah	22° 16.52'	58° 02.83'	2463709	607888	252
49	113	Sharqiya	Mudhaibi	Al-Wafi	22° 37.19'	57° 59.89'	2501813	602586	370
50	115	Sharqiya	Wadi Atayeen	Assubal	23° 06.87'	58° 32.09'	2557055	657179	434
51	116	Sharqiya	Wadi Atayeen	Al-Omsa	22° 58.82'	58° 31.87'	2542195	656959	550
52	117	Sharqiya	Wadi Atayeen	Sedab	22° 59.87'	58° 45.07'	2544256	679494	320
*53	121	Sharqiya	Wadi bani Khalid	Al-Qaryah	-	-	-	-	-
54	122	Sharqiya	Wadi bani Khalid	Al-Hajrh	22° 35.93'	59° 04.87'	2500638	713948	594
55	124	Sharqiya	Wadi bani Khalid	Halfah	22° 33.61'	59° 06.47'	2496404	717437	529
56	125	Batinah North	Liwa	Helat Shaik	24° 30.94'	56° 33.91'	2711426	455949	26
57	126	Batinah North	Liwa	Helat Alhassan	24° 30.30'	56° 33.03'	2710249	454459	28
58	127	Batinah North	Liwa	Helat Shaik	24° 30.42'	56° 33.33'	2710469	454966	20
59	131	Batinah North	Sohar	Al-mehab	24° 00.59'	56° 41.56'	2655385	468742	228
60	132	Batinah North	Saham	Shedah	23° 59.41'	56° 38.85'	2653218	464142	343
61	133	Batinah North	Saham	Al-Muntafah	24° 02.68'	57° 00.24'	2659207	500407	12
62	135	Batinah North	AL-Khabourah	Al-Sahrah	23° 51.81'	56° 38.36'	2639196	463276	544

* The team could not visit these sites as the seed samples were supplied at Agriculture Development Centers of respective Wilayats (districts)

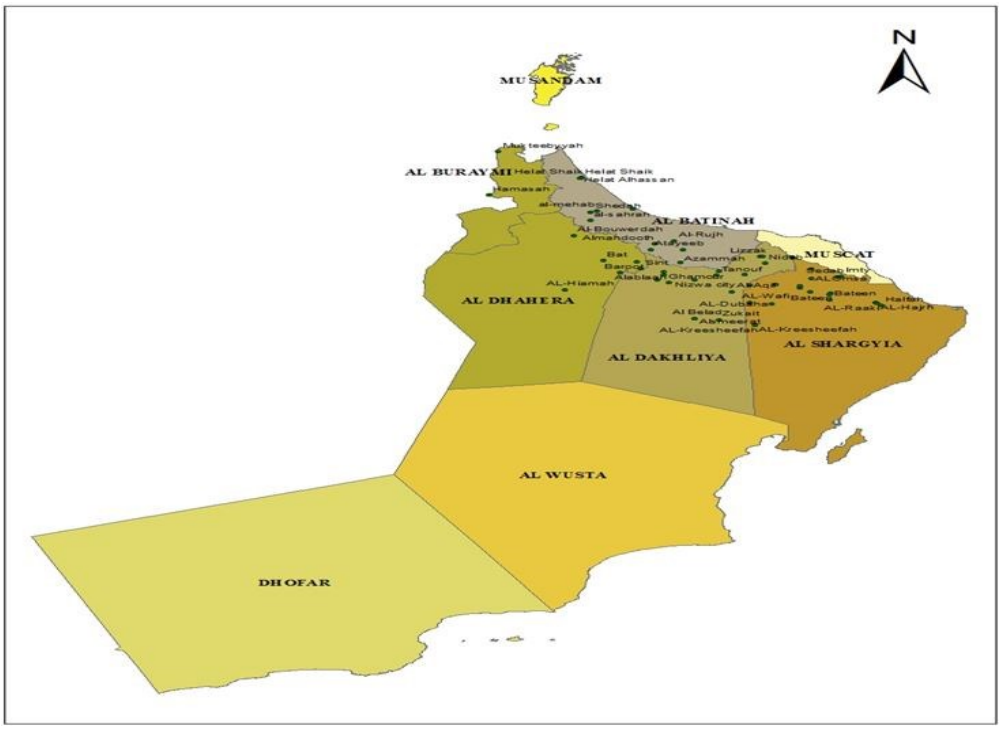

Fig. 1. Location of collecting sites of indigenous alfalfa germplasm

III. Results

Sixty seven seed samples of alfalfa were collected from different governorates; the most (25) from Sharqiya, 20 from Interior, 8 each from North Batinah and Dhahira & Buraimi, 6 from South Batinah, and none from Dhofar (Fig. 2; Table 2).

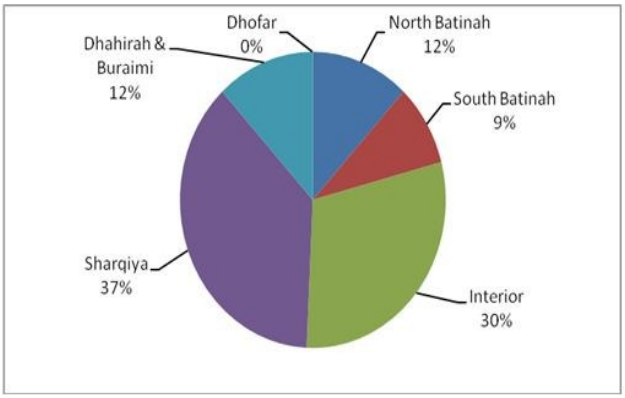

Fig. 2. Numbers of alfalfa accessions collected from different governorates of Oman between April 2008 and October 2009.

Table 2. Variation among seed characteristics of 67 alfalfa indigenous genotypes/accessions

No.	Collection No.	Length (cm)	Width (cm)	1000 seed weight (g)	Seed Nature	Color	Governorate
1	5	0.240	0.15	3.2	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
2	9	0.225	0.15	3.5	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Interior
3	26	0.265	0.14	3.4	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Interior
4	29	0.245	0.15	3.5	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
5	41	0.265	0.16	3.5	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
6	44	0.285	0.17	4	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
7	56	0.240	0.15	4	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Interior
8	60	0.235	0.15	3.8	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
9	88	0.225	0.15	3.4	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Dhahira
10	95	0.245	0.14	3.6	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Dhahira
11	98	0.250	0.16	3.6	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Dhahira
12	100	0.215	0.12	3.2	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
13	117	0.270	0.17	3.6	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Dhahira
14	131	0.235	0.14	3.3	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Batinah South
15	141	0.245	0.14	3.5	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Batinah South
16	148	0.205	0.15	3.1	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Batinah South
17	161	0.230	0.14	3.2	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Batinah South
18	167	0.275	0.18	3.3	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Batinah South
19	195	0.250	0.15	3.4	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Batinah South
20	211	0.245	0.16	3	Heterogeneous	Dark brown, brown, yellow, green	Interior
21	213	0.255	0.16	3.8	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
22	215	0.250	0.14	3.3	Heterogeneous	Dark brown, brown, yellow, green	Interior
23	216	0.255	0.15	3.7	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Interior
24	217	0.255	0.16	3.4	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Interior
25	220	0.255	0.15	3.6	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Interior
26	222	0.250	0.14	3.5	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
27	224	0.225	0.14	3.7	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
28	225	0.235	0.13	3.2	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
29	227b	0.255	0.175	3.6	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Interior
30	228	0.165	0.26	3.4	Heterogeneous	Dark brown, brown, yellow, green	Interior
31	230	0.240	0.17	4.1	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Dhahira (Buraimi)
32	234	0.265	0.17	3.8	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Dhahira (Buraimi)
33	238	0.235	0.155	3.4	Heterogeneous	Dark brown, brown, yellow, green	Dhahira (Buraimi)
34	239	0.240	0.16	3.3	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Dhahira (Buraimi)
35	244	0.175	0.20	4	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Sharqiya
36	245b	0.265	0.15	3.6	Heterogeneous	Dark brown, brown, yellow, green	Sharqiya

No.	Collection No.	Length (cm)	Width (cm)	1000 seed weight (g)	Seed Nature	Color	Governorate
37	248a	0.260	0.16	3.6	Heterogeneous	Dark brown, brown, yellow, green	Sharqiya
38	248b	0.275	0.15	3.1	Heterogeneous	Dark brown, brown, yellow, green	Sharqiya
39	252	0.280	0.2	4.5	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Sharqiya
40	253	0.270	0.18	4.1	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Sharqiya
41	257	0.265	0.15	3.3	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Sharqiya
42	258	0.245	0.14	3.7	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Sharqiya
43	259	0.235	0.14	4.2	Heterogeneous	Dark brown, brown, yellow, green	Sharqiya
44	261	0.240	0.13	3.6	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Sharqiya
45	262	0.255	0.19	3.9	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Sharqiya
46	263	0.230	0.14	3.3	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Sharqiya
47	266	0.225	0.14	3.9	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Sharqiya
48	268	0.265	0.15	3.3	Heterogeneous	Dark brown, brown, yellow, green	Sharqiya
49	270	0.225	0.13	3.1	Heterogeneous	Dark brown, brown, yellow, green	Sharqiya
50	273	0.235	0.14	3.2	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Sharqiya
51	278	0.245	0.16	2.8	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Sharqiya
52	279	0.250	0.15	3.6	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Sharqiya
53	281	0.230	0.12	3.7	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Sharqiya
54	282a	0.240	0.15	3.7	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Sharqiya
55	285	0.230	0.14	3.5	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Sharqiya
56	290	0.245	0.15	3	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Sharqiya
57	299	0.230	0.15	3.6	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Sharqiya
58	302	0.265	0.17	3.5	Heterogeneous	Dark brown, brown, yellow, green	Sharqiya
59	305	0.260	0.17	3.3	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Batinah North
60	306	0.255	0.15	2.8	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Batinah North
61	307	0.280	0.16	4.6	Heterogeneous	Dark brown, brown, yellow, green	Batinah North
62	310	0.200	0.14	3.5	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Batinah North
63	315	0.265	0.16	3.7	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Batinah North
64	317	0.225	0.15	4	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Batinah North
65	318	0.260	0.15	3.5	Heterogeneous	Tan, dark brown, dark yellow, yellow, greenish yellow	Batinah North
66	320	0.160	0.25	2.7	Heterogeneous	Dark brown, brown, yellow, green	Batinah North
67	289	0.210	0.12	4.2	Heterogeneous	Brown, tan, greenish yellow, dark yellow	Sharqiya
Minimum		0.160	0.120	2.700			
Maximum		0.285	0.260	4.600			
Mean		0.243	0.157	3.541			
S.E.(±)		0.003	0.003	0.046			

The seed accessions were diverse with respect to all seed characters studied, i.e. seed length (cm) and width (cm), 1000-seed weight (g) and seed color (Table 4). Seed length varied from 0.16 cm (Collection No. 320 of Al-Sahrah, Al-Khabora, Batinah North) to 0.28 cm (Collection No. 44 of Tawee Al-Nuseif, Behla, Interior)

with 0.243 cm as its mean whereas seed width ranged from 0.12 cm (Collection No. 289 of Al-Omsa, Wadi A'Tayeen, Sharqiya) to 0.26 cm (Collection No. 228 of Al-Aqil, Izki, Interior) with 0.157 cm as its mean. 1000-seed weight varied from 2.7 g (Collection No. 320 of Al-Sahrah, Al-Khabora, Batinah North) to 4.6 g (Collection No. 307 of Helat, Al-Hassan, Liwa, Batinah North) with its mean as 3.541 g.

Interestingly, all seed accessions were heterogeneous (mixture) with seeds of various colors, i.e. tan, greenish yellow, dark yellow, brown to dark brown. The critical analysis of seed colors of these samples indicated the presence of only three groups: the largest group had 30 seed accessions with a mixture of tan, dark brown, dark yellow, yellow, greenish yellow seeds; followed by a group with 25 seed accessions with brown, tan, greenish yellow, dark yellow seeds; and third group had 12 seed accessions with dark brown, brown, yellow, green seeds (Table 2).

Variation in Collection Sites

Collection sites varied in their soil characteristics and altitude. Altitude ranged from 12 m (Site No. 133 of Al-Muntafa, Wilayat Saham of Batinah North) to 1983 m (Site No. 24 of Balad Sait, wilayat Rustaq of Batinah South). Sites ranged in soil texture viz. sands, sandy loam, sandy clay, sandy clay loam, clay and loam. Soils were hard, firm or loose, variable-loose to crust and friable. With respect to drainage, soils were imperfect, free or variable. Soil pH ranged from 2.1 (Site No. 58, Al-Mahdooth Hajer Bani Omer, Rustaq, Batinah South and Site No. 65, Al-Qoora, Nakhal, Batinah South) to 9.9 (Site No. 87, Al-Hafeet, Buraimi). Soil EC ranged from 0.02 (Site No. 42, Al-Amq, Rustaq, Batinah South) to 22.7 dSm^{-1} (Site No. 51, Al-Ghasab, Rustaq, Batinah South). Soil color varied from light brown to dark brown.

IV. Discussion

A range of alfalfa germplasm was collected during the current mission from different governorates of Oman (Fig 1). Sharqiya contributed 37% of collections, followed by Interior (30%), North Batinah and Dhahirah & Buraimi with 12% each, and South Batinah contributing 9%. Interestingly, no samples were collected from Dhofar (South) during this mission (Fig. 2). This may be because it has typical edaphic factors and climate including disease complex known to force perennial Omani ecotypes of other regions to lose their perennial nature and behave like annuals during *Kharif* season (June to November) as they succumb to crown rust.

The examination of alfalfa seed samples in the laboratory revealed wide variation as judged by seed coat patterns (color), seed size (length and breadth) and seed weights (Table 2). Villages near collecting sites had different seed samples varying in size and colors. With seed accessions changing from village to village of different regions, it is possible that uncollected landraces still exist in other areas not visited. Seed accessions with heterogeneous seeds with respect to seed color would need intensive purification into sub-groups (Table 2).

The widespread movement of landraces of alfalfa between wilayats and neighboring regions led to the hypothesis that these landraces could be the results of centuries of selection for adaptive traits to local climatic, edaphic and cultural selection forces and contain unique gene complexes reflecting local agro-climatic evolution [9, 11, 12]. Such landraces could have been more predominant in subsistence agriculture more than 75 years ago; according to one of the farmers, his alfalfa sample was the product of continued seed harvesting from his ancestors for at least seven decades. This collecting mission provided some evidence of the adaptation of Omani landraces based on relatively small samples available from farmers, and indicated the relevance of socio-economic aspect in relation to the collection of germplasm [13]. The constant availability of local cultivars with farmers could be an important local conservation strategy for sustainable production.

Genetic erosion of landraces of alfalfa was observed in Dhofar Governorate as no seed was collected there (Figs. 1 and 2). This may be because of continuous suffering of the crop from an unknown disease complex, which recurs every year in perennial alfalfa cultivars. In addition, land degradation and fragmentation may be associated with genetic erosion. Some other common factors for genetic erosion across these regions, as discussed with the farmers, were displacement of landraces by modern high yielding varieties, changes in land use pattern, erratic drought and population movement and resettlement.

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