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Studies Relating to Relationship of Weight-Volume of Various Agricultural Crops

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Information is evaluated on relationship between weight-volume and number of seeds per kg and per litre and volume per kg of seeds. The results from this investigation would be useful in standardizing the size of container for storing seeds. The information would be useful, particularly for long-term and medium-term storage where standard size of storage space is available. Employing the knowledge of weight and volume, number of seeds in any volume of container of specific crop can be known which will help in planning, distribution, germination test and regeneration strategy of genetic stock. Number of seed samples of priority crops consisting of small, medium and bold size were evaluated. Weight-volume relationship was studied for barley, maize, paddy and wheat among cereals; Italian millet, Japanese millet, finger millet, kodo millet, little millet and proso millet among minor millets; Brassica, *sesame, groundnut, safflower and sunflower among oilseeds; blackgram, greengram, cowpea, mothbean, peas, ricebean, adzuki bean, Frenchbean and clusterbean among leguminous crops and buckwheat and sunnhemp among others. A strong positive correlation had been observed for all the crops except finger millet and Italian millet indicating that any increase in weight of seeds is accompanied by corresponding increase in volume of seeds and vice-versa. In case of finger millet, the correlation co-efficient of weight and volume was not significant, whereas in case of Italian millet the correlation co-efficient was significant at 5% level.*

A wide range of variability exists with regard to weight and volume of seeds in agri-horticultural crops. Limited information is available on relationship between weight, volume and number of seeds per unit volume. Such information is essential for working out the size of container for long term and medium term storage and for efficient use of storage space. This information would provide an approximate guide to the storage space required for germplasm of important agri-horticultural crops to be conserved at the National Gene Bank at NBPGR, New Delhi.

MATERIALS AND METHODS

Seed samples of crops with small, medium and bold size were evaluated. The crops taken up for study were barley, maize, paddy and wheat among cereals;

Italian millet, Japanese millet, finger millet, kodo millet, little millet and proso millet among minor millets; *Brassicae*, sesame, groundnut, safflower and sunflower among oilseeds; blackgram, greengram, cowpea, mothbean, peas, ricebean, adzuki bean, Frenchbean and clusterbean among leguminous crops and among others sunnhemp and buckwheat. The seeds were randomly selected from seed lots for weight and volume determination. Weight and volume were recorded for 1000 seeds in *Brassicae* and sesame, 500 seeds in Japanese millet, Italian millet, proso millet and little millet and 100 seeds in all other crops except groundnut in which 50 seeds were taken. These seeds were weighed with the help of a semi-micro electronic pan balance. From weight and volume of seeds, number of seeds per kg and per litre and volume per kg seeds were calculated using following formulae :

$$\text{No. of seeds per kg} = \frac{100{,}000}{g} \times \text{CF}$$

$$\text{No. of seeds per litre} = \frac{100{,}000}{v} \times \text{CF}$$

$$\text{Volume per kg seeds} = \frac{v}{g} \times 1000$$

where

$$\text{CF} = \frac{N}{100},$$

g = weight of 100 seeds (grams),

v = Volume of 100 seeds (cm^3), and

N = Number of seeds per sample.

RESULTS AND DISCUSSION

Weight-volume relationship

A strong positive correlation was observed between the weight and volume in all the crops except finger millet and Italian millet indicating that any increase in weight of seeds was accompanied by corresponding increase in volume and *vice-versa*.

Among leguminous crops there was a large variation of the order of 40 per cent in case of Frenchbean.

Volume of seeds

In maize, variation both in seed size and seed weight was considerable. The largest seed was more than four times the size of the smallest seed.

Among millets, proso millet had a high coefficient of variation of the order of 41 per cent.

TABLE 1. NUMBER OF SEEDS PER KG AND PER LITRE AND VOLUME PER KG SEEDS OF IMPORTANT CROPS

Name of Crop		Approximate number of seeds		Approximate volume
		per kg.	per litre	per kg. seeds (cm^3)
1	2	3	4	5
Barley	Mean	25960	15370	1710.00
(*Hordeum vulgare*)	Range	15674-40989	9615-25000	1149.00-2857.00
	CV (%)	19.95	21.47	14.85
Maize	Mean	3880	2945	1442.00
(*Zea mays*)	Range	2298-9615	1612-6667	1310.00-1674.00
	CV (%)	43.40	46.93	5.55
Paddy	Mean	51220	23730	2146.00
(*Oryza sativa*)	Range	32258-100000	16667-41667	1391.00-2867.00
	CV (%)	23.39	21.62	11.95
Wheat	Mean	35960	24240	1467.00
(*Triticum aestivum*)	Range	20534-81300	14285-43454	1168.00-1938.00
	CV (%)	33.79	23.22	9.61
Italian millet	Mean	323814	209265	1564.13
(*Setaria italica*)	Range	250000-500000	156200-294117	1111.11-2300.00
	CV (%)	17.22	15.60	16.28
Japanese millet	Mean	374041	227235	1651.82
(*Echinochloa*	Range	246305-510204	142857-294117	1475.41-1925.93
frumantacea)	CV (%)	14.81	15.71	6.00
Finger millet	Mean	286871	151062	1916.24
(*Eleusine coracana*)	Range	125000-434783	111111-263457	955.17-2344.83
	CV (%)	21.79	16.14	19.46
Kodo millet	Mean	228734	116592	1964.21
(*Paspalum*	Range	140845-312500	74074-142857	1777.78-2400.00
scrobiculatum)	CV (%)	11.38	11.12	4.91
Little millet	Mean	385729	308903	801.13
(*Panicum sumatrense*)	Range	250000-555555	200000-500000	695.65-1085.71
	CV (%)	15.81	18.70	10.40
Proso millet	Mean	270129	202681	1432.92
(*Panicum miliaceum*)	Range	135135-568182	94339-357142	505.42-4431.82
	CV (%)	51.76	48.96	41.41
Oleiferous	Mean	335233	191881	1752.15
Brassicae	Range	217391-526315	125000-285714	1351.35-2142.86
	CV (%)	16.85	15.53	9.72
Groundnut	Mean	3232	1909	1694.09
(*Arachis hypogaea*)	Range	2000-5882	1250-2941	1437.50-2545.45
	CV (%)	16.34	14.46	7.68
Safflower	Mean	24721	11989	2073.32
(*Carthamus tinctorius*)	Range	13888-34246	6666-16665	1574.10-4629.60
	CV (%)	17.46	15.29	16.84

TABLE 1. (*Continued*)

(1)		(2)	(3)	(4)
Sunflower	Mean	15786	5610	2859.21
(*Helianthus annuus*)	Range	9242–31250	2777–11111	2343.75–4189.19
	CV (%)	26.59	29.82	11.85
Sesame	Mean	341030	205240	1675.15
(*Sesamum indicum*)	Range	147059–584795	153846–370370	735.29–2115.38
	CV (%)	21.62	22.24	12.63
Blackgram	Mean	31701	20444	1554.52
(*Vigna mungo*)	Range	18181–41666	14285–27777	1000.00–2205.32
	CV (%)	15.13	13.86	10.37
Greengram	Mean	34960	23538	1494.80
(*Vigna radiata*)	Range	16474–54347	100000–33333	1145.80–2039.80
	CV (%)	21.94	22.84	9.45
Cowpea	Mean	11500	8376	1380.74
(*Vigna sinensis*)	Range	6105–26666	4545–20000	1096.29–1584.91
	CV (%)	32.45	32.72	6.44
Mothbean	Mean	39767	31317	1273.67
(*Vigna aconitifolia*)	Range	30303–55555	23809–50000	1052.60–1388.90
	CV (%)	11.50	13.79	3.83
Peas	Mean	8414	5642	1491.73
(*Pisum sativum*)	Range	4347–20000	2857–12500	941:18–2209.30
	CV (%)	29.82	25.94	13.75
Rice bean	Mean	16205	12336	1324.20
(*Vigna umbellata*)	Range	8554–24630	6060–25881	744.00–1576.58
	CV (%)	22.62	25.34	7.71
Adzukiban	Mean	8535	6300	1355.03
(*Vigna angularis*)	Range	4842–15748	3546–10989	848.03–1495.73
	CV (%)	32.58	30.58	8.04
French bean	Mean	4388	3342	1344.91
(*Phaseolus vulgaris*)	Range	1759–8984	1190–8333	324.97–2296.21
	CV (%)	37.78	42.20	10.72
Clusterbean	Mean	29092	23096	1275.88
(*Cyamopsis tetragonoloba*)	Range	24875–38462	19230–33333	967.74–1615.30
	CV (%)	7.44	15.18	9.71
Sunnhemp	Mean	24578	17897	1377.44
(*Crotalaria juncea*)	Range	17331–32573	13333–22222	1116.63–1837.27
	CV (%)	11.39	10.65	9.49
Buckwheat	Mean	50037	28957	1742.58
(*Fagopyrum esculentum*)	Range	35971–70125	18519–500000	1292.13–2180.09
	CV (%)	16.74	19.54	8.54

Except for blackgram, mothbean and clusterbean, the variation in volume of seeds was high. The largest seed was three to four times the size of the smallest seed. In Frenchbean, the largest seed was seven times the size of the smallest

seed. In case of Frenchbean, the volume of 100 seeds varied from 12 to 84 cm^3 with a coefficient of variation of 41 per cent and the mean volume 35.47 cm^3.

Number of seeds per kg and per litre

High variation of the order of 30-40 per cent was observed both in the number of seeds per kg as well as number of seeds per litre in case of cowpea, pea, Frenchbean and adzuki bean. It was also observed that there was comparatively larger variation, both in number of seeds per kg and per litre for bold seeded as compared to the small seeded ones.

Volume per kg seeds

There was little variation between the lowest and the highest values in the oilseed and leguminous crops as well as in sunnhemp and buckwheat.

The percentage of samples falling in low, medium and high ranges were worked out for each of the crops for all the characters. These ranges varied from crop to crop. This could be used to determine the number of seed samples which were likely to fall within a particular range and to have an idea of an approximate/ average seed size of a specific crop.