BIBLIOGRAPHY

SUBELAN, RONALINDA G. APRIL 2006. Characterization, Diversity and Cluster Analysis of Different Accessions of Garden Pea (*Pisum sativum* L). Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The 154 accessions of garden pea were characterized to estimate variation through diversity and cluster analysis.

The 154 accessions differed in the characters observed in this study. Out of the 154 accessions observed, 20 were selected and identified promising materials for commercialization because of their prolificacy and pod quality.

Diversity analysis revealed high variation within the collection of the accessions at BSU-IPB-HCRS. The computed diversity indices for the quantitative characters ranged from 0.63 (number of days from flowering to pod setting) to 0.99 (number of flower per cluster) with a mean of diversity index of 0.87. The diversity indices for quantitative characters ranged from 0.34 to 0.99 with a mean diversity index of 0.73. Pooling of diversity indices for all the characters observed gave an overall mean diversity index of 0.80 an indication of high variation within the collection.

Cluster analysis for the 28 characters formed 14 distinct clusters at the dissimilarity coefficient of 14.73. There were eight single character clusters and six two to six character clusters. This indicated that clusters with single character were distinct

from each other and form clusters with 2 or more characters, Cluster analysis for accessions resulted in the formation of a tree with 41 clusters at a dissimilarity coefficient of 0.50. There were 14 single accession clusters, 10 two accession clusters and 17 3 to 15 accession clusters. Clusters with one accession, signified distinctness from the other single accession clusters. The existence of clusters with three or more accessions indicated the presence of high variation among clusters of the accessions studied and high similarities of accessions within a cluster.

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INTRODUCTION

Among crops raised in the country, garden pea (*Pisum sativum* L.) is freshly shelled and rank high in protein, calories and in ascorbic acid (Vitamin C). It is widely grown and consumed as a fresh succulent vegetable or as dried seed and for canned or frozen. Seeds are round, soft, smooth or wrinkled and contain more sugar (Purseglove, 1972). It is one of the vegetable legumes that can be profitably grown in high elevated areas having cool climate. It is grown for its economic and nutritional values.

Success in acquiring good quality and high yielding garden pea calls for a thorough knowledge of its climatic requirement and adaptation of a good varieties. Most developing countries face the general problem of malnutrition, particularly the deficiency of protein in diet. Because of its nutritional importance, production of vegetable legume like garden pea must be increased to meet the demand of the increasing population.

Morphological characterization is one way of documenting variety traits that can be used to distinguish one variety from other varieties. One of the major goals of any plant improvement program is to increase profitability of the crop. Since yield is a major concern in developing new pea cultivars. At the same time, quality of the shelled peas must be maintained or improved to encourage consumption (Basset, 1977).

Usually high heritable morphological characters are employed for the purpose of characterization (IBPGR, 1981). It includes a sufficient number of traits that are useful in eliminating duplicates. It is important in establishing the identity of a variety and assessing its agronomic utilization potential. It is also important in the field of agriculture for breeders, researchers and producers to further evaluate the characteristics of the existing varieties, species and progenies adapted to cold and warm conditions.

High diversity of the crop is beneficial to a particular area. Although not all necessarily often the kind of yield characteristics desired by farmers, the fact is that each and every variety probably carries genes of superior quality. By crossing varieties of inferior yield qualities could result in new superior strains. For this reason, the existence of such high diversity should be maintained (Sawor *et. al*, 1993)

The study was undertaken to characterize the different accessions of garden pea to estimate variation among accessions through diversity and cluster analysis.

The study was conducted at the Benguet State University-Institute of Plant Breeding Highland Crops Research Station (BSU-IPB-HCRS) from October 2005 to March 2006.

REVIEW OF LITERATURE

Importance of Characterization

Characterization is based on agro-morphological characteristics of plants. Standardized descriptions are used to characterize materials so that information exchange of genetic resources is more accessible to researchers and plant breeders. Breeders could use them as references for exploiting new traits that is desirable and related to yield. Characters of importance should be identified to correlate with yield and later improvement could be done (Borromeo, *et al., 1994*). IPGRI in 1994 emphasized that characterization of genetic diversity of organisms can't be achieved with phenotypic traits and molecular markers, which may not always correlate. Phenotypic traits have the advantage that they may be directly related to the fitness of the populations and usefulness for plant breeding. A thorough evaluation of traits requires multi location, multi year trials to account for environmental effect and genotypes x environment interaction.

Morphological characterization is done to identify morphotypes. A morphotype is a group of plants showing morphological similarities, apparently of the same phenotype, but not necessarily of the same genetic constitution. Thus, molecular characterization can follow to identify genotypes. At this stage, a curator has an efficient collection with a minimum of duplicates. Consequently, the collection is smaller than the original one. Studies on genetic diversity and evaluation such as agronomic characters, nutrition, and reaction to biotic and abiotic factors can be carried out on this kind of material. Once that has been achieved, a core collection (basic sample of a germplasm collection representing

the wide range of diversity in terms of morphology, geographical coverage and genes) can be established (Fontanetti, *et al*., 2002).

Importance of Diversity

Analysis of the level of diversity among improved varieties is used in breeding programs as this influences parental selection in succeeding varietal development (Caldo and Hipolito, 1996). Maintenance of the diversity helps to ensure the specific cultivars that are available when and where farmers need. To achieve this local knowledge is an essential resource for identifying, cultivating, utilizing and preferences, adaptability to local growing conditions and traditional beliefs and practices. Serve as a major impetus to conserve diversity. However, increased market orientation and new livelihood opportunities have reduced diversity, mainly threatening those cultivars that have no immediate economic value which underscores the needs for farmers to conserve cultivar diversity for strategic purpose against the backdrop of changing socio, cultural, economic and agro-ecological environments (Campilan, 2002) as cited by Rebujio, 2003. Conservation and management of valuable genetic resources collection entails an understanding of the nature and structure of genetic diversity existing within it (Siopongco *et al.*, 1999). Ignacio (2005) stated that there was variability for most of the morphological characters of rice bean. The high diversity indices indicate the existence of high variation within the collection of characters. Selection for characters could be done due to high diversity index. Selection may warrant future improvement of the crop.

Heritability

Heritability is the proportion of the total variation in a progeny that is a result of genetic factor and may be transmitted (Poehlman, 1997). Heritability refers to the extent to which a phenotypic trait is under genetic control. Most traits of interest are to some degree polygenic (that is, controlled by multiple genes), and their expression may be further modified by environmental (non-genetic) factors. The question of heritability is exactly the basis for the nature vs. nurture debates that have surrounded study of traits such as human intelligence, aggression, homosexuality and creativity. The heritability determines (along with the strength of artificial or natural selection) the response to selection, or the magnitude and rate of change in a character from one generation to the next as a function of selection.

Parent-offspring Regression

It is a specific phenotypic trait that is measured for both the parent and the offspring at the same age and compared using regression. The slope of regression of offspring is a comparison between either the mother or father and the offspring and gives an estimate of half of the narrow sense heritability. The slope of the father-offspring regression may differ from mother-offspring regression due to maternal effects, a component of the environmental variance and could be used to determine the effect of the maternal effects, a component of the environmental variance and could be used to determine the effect of the maternal environment on a specific trait (Hof, 1996).

Selection among F1-Derived

Gamete selection in the F1, when combined with early generation evaluation and selection, helps identify promising populations and families within population. These are used to develop superior line for subsequent evaluation and new cultivar selection. Both qualitative traits between and within F1 derived families are selected, seed yield is determined in diverse environments representative of the pea production. Development and evaluation is to develop breeding lines possessing multiple desirable traits and to conform seed, plant and adoption characteristics, by selecting promising families to use (Kang, 2002)

MATERIALS AND METHODS

One hundred forty four progenies and ten maternal varieties of garden pea were planted following a serpentine system. An area of 100 m^2 divided into 10 plots was planted maintaining 20 cm distance between hills and 2 cm depth at a rate of one seed per hill. Appropriate cultural management practices were provided throughout the growth of the plant.

The following were the treatments used:

TREATMENT

CLG and 16 progenies

89-001 and 19 progenies

CGP-116 and 26 progenies

CGP-154 and 25 progenies

CGP-34 and 26 progenies

CGP-11 and 8 progenies

CGP-59 and 7 progenies

CGP-18A and 8 progenies

N335 and 7 progenies

CGP-13 and CGP 13 x 89-001 (2 progenies)

In this study the different entries that served as treatments were called accessions (Accs).

Data Collection

At particular stages of growth, characterization of qualitative and quantitative morpho-agronomic characters was done based on descriptors list for snap bean and chick pea (IBPGR, 2004). Results were presented using descriptive method.

A. Quantitative characters

1. Maturity

a. Number of days from sowing to emergence. This was recorded by counting the number of days from sowing to emergence of seedlings.

b. Number of days from emergence to first flowering. This was recorded by counting the number of days from emergence to first flowering.

c. Number of days from emergence to last flowering. This was recorded by counting the number of days from emergence to last flowering.

d. Number of days from flowering to pod setting. This was recorded by counting the numbers of days from flowering until the pods were fully developed.

e. Number of days from pod setting to seed maturity. This was recorded by counting the number of days from pod setting to seed maturity.

2. Leaflet Characteristics

a. Leaflet length (cm). This was measured using a foot ruler from the base of the petiole to the tip of the leaves at 35 days after planting (DAP).

b. Leaflet width (cm). This was gathered using a foot ruler measuring the broadest part of the leaves at 35 DAP.

c. Tendril length (cm). This was measured from the base to the tip of the tendril using a ruler when the plants were fully mature.

3. Stem Characteristics

a. Plant height at 35 DAP. This was measured from the base of the plant at ground level to the tip of the youngest shoot using a meter stick at 35 DAP.

b. Diameter of stem (cm). This was measured at the mid-portion of the plant using vernier caliper at 35 DAP.

c. Number of nodes per plant. This was counted from the base of the plant to the tip of the main stem.

d. Node number bearing first flower cluster. This was recorded by counting the nodes from the base of the plant to the node bearing the first flower cluster.

e. Node number bearing last pod cluster. This was recorded by counting the nodes from the base of the plant to the node bearing the last pod cluster.

f. Internode length (cm). This was measured by getting the mean length of three internodes at the midpoint of the plant.

g. Number of branches. This was obtained by counting the branches of the plants one week before harvesting

h. Final plant height (cm). This was measured from the base of the plant to the tip of the plant using a meter stick at maturity.

4. Flower characteristics

a. Number of flowers per cluster. This was recorded by counting the number of flower/s per cluster.

5. Pod Characteristics

a. Pod length (cm). This was obtained by measuring the base to the tip of the pod of ten sample pods.

b. Pod width (cm). This was obtained by measuring the broadest part of the pod used in gathering pod length using a ruler.

c. Number of pod cluster per plant. This was obtained by counting the number of pods cluster per plant.

d. Number of pods per cluster. This was obtained by counting the number of pods per cluster.

6. Seed Characteristics

a. Number of seeds per pod. This was obtained by counting the number of from ten sample pods.

B. Qualitative characters

1. Leaf color. This was recorded when plants are at their maximum vegetative growth about 35 DAP using the Royal Horticultural Society Color Chart (RHSCC).

2. Flower color. This was recorded by visually looking at the flowers when they were fully opened using RHSCC.

3. Pod color. This was recorded as green, light green, yellow, dark green when the pods were fully developed.

4. Pod shape. This was recorded as flat, curve or straight.

5. Stringiness. This was recorded during harvest and recorded whether the green pod is stringy or stringless. Stringy if there is pod suture string when snapped and stringless when there is no pod suture.

6. Waxiness of pod. This was recorded by observing the presence or absence of wax in the pods.

7. Seed color. This was obtained by visual observation of the seeds using RHSCC.

8. Seed shape. This was recorded as round, smooth, wrinkled, cubical and flattened.

Data Analysis

The quantitative and qualitative data gathered were described and discussed using percentage and ranges.

Quantification of Variation Using the Shannon-Weaver Diversity Index

Estimate of variability for each quantitative and qualitative character was computed using the standardized Shannon-Weaver Diversity Index, designated as H', for qualitative the following formula was used:

$$H' = \sum pi^* \log_2 Pi/\log_2 K$$

Where pi = relative frequency

K = number of descriptor states

Following the work of Pecetti *et al*. (1992), the same formula was applied to the quantitative character following construction of the frequency classes, with the class boundaries equal to some function of mean and standard deviation. For each character, the overall entry mean (X) and standard deviation (O) was used to subdivide the accession values (X1) into frequency classes, with a class width of 0.50. The lowest and highest values were considered to determine the number of classes to construct. The following formula was used to estimate variability in quantitative characters.

$$H' = \sum pi^* \log_2 Pi / \log_2 n$$

Where pi = relative frequency

N = number of classes

The Shannon Weaver Diversity Index has a value ranging from 0 to 1, where 0 indicates absence of diversity and 1 indicates maximum diversity.

Cluster Analysis

Using standardized data, numerical measures of likeness/similarity were computed and distance matrix was constructed using Dissimilarity Coefficients. Clustering (Sequential, Agglomerative, Hierarchical, Nested) by UPGMA (Unweighed Pair Group of Arithmetic Mean) method used by Siopongco in 1997 was followed.

RESULTS AND DISCUSSION

A. Characterization

Quantitative Characters

Maturity

Number of days from planting to seed emergence. Table 1 shows the number of days from planting to seed emergence of the 154 accessions of garden pea studied. Seventy percent of the total accessions emerged in seven days and 30 % emerged 5 days after sowing.

Number of days from emergence to first flowering. Among the 154 accessions of garden pea observed, Acc 39 was the earliest to bear flower at 25 days after emergence and Acc 105 was the latest at 58 days after emergence as shown in Table 1.

Number of days from emergence to last flowering. As also shown in Table 1, Acc 153 was the earliest to stop flowering at 54 days from emergence while Acc 36 was the latest at 86 days after emergence.

Number of days from flowering to pod setting. The number of days from flowering to pod setting of the garden pea accessions ranged from three to nine days. This was recorded when the pods were fully developed (Table 1).

Number of days from pod setting to seed maturity. Table 1 presents that Acc 29 was the earliest to mature at 27 days while Accs 5 and 7 were the latest to mature at 47 days from pod setting.

Table 1. Maturity indices of 154 garden pea accessions

ACC NO.	NUMBER OF DAYS FROM:				
	PLANTING TO SEED EMERGENCE	EMERGENCE TO 1ST FLOWERING	EMERGENCE TO LAST FLOWERING	FLOWERING TO POD SETTING	POD SETTING TO SEED MATURITY
Acc1	5	38	68	5	35
Acc2	5	37	66	7	35
Acc3	7	36	79	9	32
Acc4	7	36	66	5	35
Acc5	7	38	77	8	47
Acc6	7	36	67	5	35
Acc7	7	48	69	5	47
Acc8	5	36	68	7	37
Acc9	7	36	62	5	33
Acc10	7	37	65	5	39
Acc11	7	46	69	4	39
Acc12	7	45	69	4	39
Acc13	7	36	62	7	39
Acc14	7	36	58	5	33
Acc15	7	34	67	4	35
Acc16	7	36	65	2	37
Acc17	7	35	66	5	35
Acc18	7	36	60	5	35
Acc19	7	38	62	5	35
Acc20	7	38	63	6	35
Acc21	7	38	62	5	36
Acc22	7	42	69	4	36
Acc23	7	27	57	5	34
Acc24	7	34	62	6	34
Acc25	5	38	68	6	34
Acc26	5	49	49	7	37
Acc27	7	45	45	5	37
Acc28	7	42	42	5	37
Acc29	7	35	59	5	27
Acc30	5	36	67	7	35
Acc31	7	33	66	6	35
Acc32	5	45	55	5	28
Acc33	7	27	68	7	34
Acc34	5	29	63	7	34
Acc35	7	33	66	5	30
Acc36	5	48	68	5	30
Acc37	7	26	71	6	35
Acc38	7	47	70	4	35
Acc39	7	25	65	6	36
Acc40	5	35	66	6	36
Acc41	7	34	66	6	34
Acc42	7	35	63	6	35
Acc43	5	36	64	7	35
Acc44	7	39	68	7	32
Acc45	7	43	66	4	28
Acc46	7	48	78	5	35
Acc47	7	42	70	4	28
Acc48	7	43	76	5	35

Table 1 continued…

ACC NO.	NUMBER OF DAYS FROM:				
	PLANTING TO SEED EMERGENCE	EMERGENCE TO 1ST FLOWERING	EMERGENCE TO LAST FLOWERING	FLOWERING TO POD SETTING	POD SETTING TO SEED MATURITY
Acc49	7	43	71	5	34
Acc50	5	52	69	4	32
Acc51	7	40	70	6	32
Acc52	7	48	72	4	28
Acc53	7	46	70	4	30
Acc54	7	46	68	4	30
Acc55	7	46	70	4	30
Acc56	7	45	67	4	31
Acc57	7	45	70	4	31
Acc58	7	46	70	3	31
Acc59	7	46	70	3	31
Acc60	7	41	72	5	35
Acc61	7	42	66	5	34
Acc62	7	41	68	6	34
Acc63	5	42	68	4	34
Acc64	7	35	64	7	35
Acc65	5	44	68	5	37
Acc66	5	45	68	5	32
Acc67	5	43	74	5	34
Acc68	5	45	73	5	35
Acc69	5	40	68	6	32
Acc70	5	38	68	5	35
Acc71	7	46	70	6	35
Acc72	7	45	66	3	35
Acc73	7	45	61	4	34
Acc74	7	33	62	6	35
Acc75	7	38	73	6	32
Acc76	7	37	66	5	34
Acc77	7	42	66	3	34
Acc78	7	46	74	5	34
Acc79	7	36	74	5	36
Acc80	7	37	66	5	37
Acc81	5	36	66	6	37
Acc82	5	37	64	3	35
Acc83	7	48	77	4	34
Acc84	7	38	63	7	35
Acc85	5	39	68	6	32
Acc86	5	37	68	7	34
Acc87	7	34	66	6	34
Acc88	5	37	67	4	34
Acc89	7	46	77	6	35
Acc90	7	35	71	6	34
Acc91	5	33	71	5	34
Acc92	7	44	71	5	36
Acc93	7	36	64	7	32
Acc94	7	44	76	6	35
Acc95	7	44	71	6	33
Acc96	7	41	71	4	34

Table 1 continued…

ACC NO.	NUMBER OF DAYS FROM:				
	PLANTING TO SEED EMERGENCE	EMERGENCE TO 1ST FLOWERING	EMERGENCE TO LAST FLOWERING	FLOWERING TO POD SETTING	POD SETTING TO SEED MATURITY
Acc97	7	43	71	5	36
Acc98	7	33	64	6	35
Acc99	5	37	66	5	35
Acc100	7	37	66	5	32
Acc101	7	42	67	5	32
Acc102	7	46	69	5	32
Acc103	7	37	66	4	32
Acc104	5	43	66	4	34
Acc105	5	58	76	6	32
Acc106	7	44	65	5	35
Acc107	7	43	66	5	34
Acc108	5	40	63	6	34
Acc109	7	42	71	4	35
Acc110	7	46	70	6	32
Acc111	7	42	70	4	33
Acc112	5	48	68	5	34
Acc113	5	40	64	4	35
Acc114	5	48	68	7	35
Acc115	7	48	66	4	36
Acc116	7	46	64	6	34
Acc117	5	43	72	4	35
Acc118	5	44	71	5	35
Acc119	7	40	66	6	35
Acc120	5	44	68	4	32
Acc121	7	43	66	4	34
Acc122	5	43	64	5	34
Acc123	7	46	66	5	34
Acc125	5	37	68	5	35
Acc126	5	38	67	5	36
Acc127	5	32	62	6	36
Acc128	5	31	62	7	38
Acc129	5	31	62	6	39
Acc130	7	30	65	4	39
Acc131	7	37	78	5	35
Acc132	7	41	70	4	34
Acc133	7	41	71	4	34
Acc134	7	44	76	5	34
Acc135	5	44	73	3	35
Acc136	7	37	71	5	34
Acc137	7	35	66	6	36
Acc138	7	41	71	5	35
Acc139	7	41	69	5	35
Acc140	7	41	71	4	35
Acc141	7	40	71	4	35
Acc142	7	42	71	4	30
Acc143	5	32	68	7	35
Acc144	7	28	62	6	34
Acc145	7	37	66	4	34

Table 1 continued…

ACC NO.	NUMBER OF DAYS FROM:				
	PLANTING TO SEED EMERGENCE	EMERGENCE TO 1ST FLOWERING	EMERGENCE TO LAST FLOWERING	FLOWERING TO POD SETTING	POD SETTING TO SEED MATURITY
Acc146	7	36	60	5	34
Acc147	7	37	62	4	36
Acc148	7	37	63	4	35
Acc149	7	35	61	5	34
Acc150	7	35	64	5	30
Acc151	7	29	60	8	30
Acc152	7	36	62	5	30
Acc153	7	27	54	5	30
Acc154	7	37	72	4	35
TOTAL	990	6,104	10,319	790	7,273
Variance	0.82	31.7	29.64	1.3	7.32
Standard Variation	0.91	5.63	5.44	1.14	34.240
MEAN	6.429	39.636	67.006	5.130	24.240

Leaflet Characters

Leaflet length. Among the 154 garden pea accessions, Acc 68 exhibited the longest leaflet of 7.6 cm while Accs 2 and 153 exhibited the shortest leaflet of 4.1 cm. Most of the accessions exhibited 6.7 cm leaflet length (Table 2).

Leaflet width. Table 2 presents that Acc 34 had the widest leaflet of 7.5 cm while Acc 153 had the narrowest leaflet (3.1 cm).

Tendril Length

As shown in Table 2, Acc 54 had the longest tendril of (8.9 cm) while Acc 153 had the shortest tendril (3.8 cm). Most of the accessions had tendril lengths ranging from 5.7 to 6.5 cm. Longer tendril is an advantage in garden pea to support the plant twining on the trellis (Paganas, 2005).

Number of Flower/s Per Cluster

Table 2 shows that 80 % of the accessions had one flower per cluster and the rest had two flowers per cluster.

Table 2. Leaflet characters, tendril length and number of flowers per cluster of 154 garden pea accessions

ACC NO.	LEAFLET LENGTH (cm)	LEAFLET WIDTH (cm)	TENDRIL LENGTH (cm)	NO. OF FLOWER/CLUSTER
Acc1	4.3	3.4	5.3	1
Acc2	4.1	3.5	5.7	1
Acc3	6.0	4.8	7.1	2
Acc4	5.1	5.1	7.7	1
Acc5	4.8	4.4	8.1	2
Acc6	5.5	5.7	5.6	2
Acc7	5.9	3.9	5.1	2
Acc8	6.3	5.9	6.5	2
Acc9	5.6	5.4	5.6	2
Acc10	5.6	4.6	6.9	2
Acc11	6.8	5.5	6.5	2
Acc12	7.3	5.5	7.0	2
Acc13	5.0	4.4	7.8	1
Acc14	5.2	5.4	5.0	2
Acc15	5.1	3.7	6.0	1
Acc16	4.9	4.3	6.5	1
Acc17	5.2	4.1	6.6	1
Acc18	5.7	4.3	6.7	1
Acc19	5.5	4.6	6.6	1
Acc20	5.0	4.3	6.5	1
Acc21	4.5	3.5	5.0	1
Acc22	4.3	3.2	6.0	1
Acc23	5.2	4.3	4.5	1
Acc24	5.6	4.7	6.7	2
Acc25	5.8	4.7	6.7	1
Acc26	6.4	5.7	7.9	2
Acc27	6.9	5.6	6.6	2
Acc28	4.8	3.8	4.7	2
Acc29	5.8	4.9	5.3	1
Acc30	4.8	3.7	5.6	1
Acc31	5.5	5.2	7.6	1
Acc32	5.6	5.2	7.5	2
Acc33	5.8	5.1	6.7	1
Acc34	7.4	7.4	7.4	1
Acc35	5.7	5.8	6.2	2
Acc36	6.5	5.7	8.0	2
Acc37	5.3	4.5	5.5	1
Acc38	5.8	5.4	7.0	1
Acc39	6.3	5.4	7.2	1
Acc40	5.7	5.2	5.4	1
Acc41	6.5	5.8	8.1	1
Acc42	5.8	5.1	5.9	1
Acc43	5.4	5.1	4.6	1
Acc44	4.9	4.5	5.5	1
Acc45	6.2	5.5	5.2	2
Acc46	4.9	5.0	6.2	1
Acc47	6.1	5.1	6.8	1
Acc48	5.1	4.7	6.8	1
Acc49	6.2	5.2	7.1	2

Table 2 continued…

ACC NO.	LEAFLET LENGTH (cm)	LEAFLET WIDTH (cm)	TENDRIL LENGTH (cm)	NO. OF FLOWER/CLUSTER
Acc50	6.3	5.7	6.6	1
Acc51	6.5	5.6	5.7	1
Acc52	7.0	5.8	8.4	2
Acc53	6.7	4.9	7.9	2
Acc54	7.1	6.0	8.9	2
Acc55	7.0	5.8	7.1	2
Acc56	6.7	5.5	6.8	2
Acc57	6.5	5.5	6.8	2
Acc58	7.2	6.3	8.1	2
Acc59	7.1	5.4	8.1	2
Acc60	6.2	5.8	5.7	2
Acc61	7.0	6.4	5.8	2
Acc62	6.0	6.1	5.0	2
Acc63	6.5	5.8	6.1	2
Acc64	5.7	4.9	6.9	1
Acc65	7.4	5.9	5.8	2
Acc66	7.3	6.0	6.8	2
Acc67	6.5	5.4	4.6	2
Acc68	7.6	6.4	9.7	2
Acc69	4.7	4.0	6.9	1
Acc70	6.4	5.6	8.0	1
Acc71	6.5	5.7	7.2	2
Acc72	6.6	6.1	7.4	2
Acc73	6.7	5.4	7.1	2
Acc74	5.4	5.6	4.4	1
Acc75	6.0	5.1	8.4	1
Acc76	5.9	5.6	7.7	1
Acc77	6.7	5.8	6.2	2
Acc78	7.6	6.3	7.5	2
Acc79	5.5	4.6	7.3	2
Acc80	7.3	6.0	7.8	1
Acc81	6.1	5.0	7.1	2
Acc82	5.9	4.9	6.5	1
Acc83	6.2	5.7	8.0	1
Acc84	7.5	6.9	8.8	1
Acc85	6.1	4.9	4.9	2
Acc86	5.6	5.2	7.1	1
Acc87	6.3	6.5	6.1	1
Acc88	5.4	4.8	7.0	1
Acc89	6.0	5.2	6.5	1
Acc90	5.9	5.5	8.2	1
Acc91	5.9	5.5	8.5	1
Acc92	7.0	5.4	6.4	1
Acc93	6.4	5.9	6.7	1
Acc94	6.4	4.6	6.2	1
Acc95	6.7	6.0	6.0	1
Acc96	6.1	6.0	8.4	1
Acc97	7.0	6.4	7.7	1
Acc98	7.0	5.3	8.6	1
Acc99	5.8	5.3	7.4	1
Acc100	5.3	5.5	6.1	2

Table 2 continued…

ACC NO.	LEAFLET LENGTH (cm)	LEAFLET WIDTH (cm)	TENDRIL LENGTH (cm)	NO. OF FLOWER/CLUSTER
Acc101	6.7	5.7	5.7	2
Acc102	6.8	4.9	6.0	2
Acc103	6.8	5.7	7.1	1
Acc104	5.8	5.2	4.7	1
Acc105	7.5	5.4	7.4	2
Acc106	6.9	5.3	6.6	1
Acc107	6.7	5.2	6.0	2
Acc108	4.6	4.6	4.0	1
Acc109	7.3	5.9	7.4	2
Acc110	6.1	5.1	6.0	1
Acc111	7.2	6.2	7.4	1
Acc112	6.7	5.3	6.5	2
Acc113	5.6	4.8	4.5	2
Acc114	5.6	4.0	5.5	2
Acc115	6.7	4.7	7.0	2
Acc116	7.2	5.4	5.1	2
Acc117	5.6	4.9	5.5	2
Acc118	6.0	5.1	6.2	2
Acc119	6.2	5.6	8.0	2
Acc120	6.0	4.9	6.0	1
TOTAL	931.10	798.80	1,010.50	220
Variance	0.63	0.53	1.23	0.25
Standard variation	0.80	0.73	1.11	0.50
MEAN	6.046	5.187	6.562	1.429

Stem Characters

Plant height at 35 days after planting. Table 3 shows that Acc 93 had the tallest plant at 35 DAP (59 cm) while the height of the rest of the accessions ranged from 35 to 48 cm.

Stem diameter. Accs 43 and 122 had the broadest stem diameter of 0.8 cm while the other accession had stem diameters ranging from 0.4 to 0.6 cm (Table 3).

Number of nodes per plant. Accs 111 had 32 nodes, recorded as the highest while Accs 33 and 12 nodes, recorded having the least number of nodes per plant. The rest of the accessions had nodes ranging from 23-29 nodes per plant (Table 3).

Node number bearing first flower cluster. Table 3 also presents the node number bearing first flower cluster of the garden pea accessions. It was noted that Accs 127, 130, 143, 144 and 151 bear first flower cluster at the 8th node from the base of the plant while Accs 11, 12, 71, 72, 77, 106 and 114 bore first flower cluster at the 21st node from the base of the plant.

Node number bearing last flower cluster. As shown in Table 3, Acc 33 bore its last flower on its 12th node while Acc 111 bore its last flower cluster on its 32nd node from the base of the plant.

Internode length. Among the accessions characterized, Acc 34 had the longest internode (11.1 cm) while Acc 5 had the shortest internode of 4.7 cm (Table 3).

Number of branches. As noted in Table 3, Acc 120 had the highest number of branches (18) while Acc 144 had the lowest number of branches (2).

Final plant height. Acc 137 was the tallest among the accessions studied with a final plant height of 193 cm while Acc 14 was the shortest with 100 cm plant height (Table 3).

Pod and Seed Characters

Pod length. As shown in Table 4, Acc 142 had the longest pod length of 8.8 cm while Acc 26 had the shortest pod (5.1 cm). The rest of the accessions had pod length ranging from 6.0 to 7.5 cm.

Pod width. Acc 49 had the widest pod measuring 1.9 cm while Acc 26 had the narrowest pod measuring 1.1 cm. Pod width of the other accessions ranged from 1.3 to 1.5 cm (Table 4).

Number of pod cluster per plant. Table 4 shows that Acc 141 produced the highest number of pod cluster per plant (92) while Acc 73 had the least number of pod cluster per plant (20).

Number of pods per cluster. Among the garden pea accession characterized, 56 % had one pod per cluster while 44 % had two pods per cluster (Table 4)

Number of seeds per pod. Table 4 presents that all the accessions had 2 to 8 seeds per pod. Thirty percent of the garden pea accessions had five seeds per pod.

Table 3. Stem characters of 154 garden pea accessions

ACC NO.	PLANT HEIGHT (35 DAP)	STEM DIAMETER (CM)	NO. OF NODES/ PLANT	NODE NO. BEARING 1ST FLOWER CLUSTER	NODE NO. BEARING LAST FLOWER CLUSTER	INTER-NODE LENGTH (CM)	NUMBER OF BRANCHES	FINAL PLANT HEIGHT (CM)
Acc1	46	0.5	29	17	28	10.2	12	165
Acc2	57	0.5	28	16	28	6.8	7	135
Acc3	25	0.3	25	10	25	6.7	4	150
Acc4	44	0.7	22	14	22	8.6	8	151
Acc5	35	0.3	28	9	28	4.7	4	132
Acc6	51	0.6	22	16	21	8.3	11	126
Acc7	22	0.2	24	12	24	10.8	4	174
Acc8	51	0.7	23	14	23	7.8	8	119
Acc9	40	0.7	24	15	23	8.1	7	119
Acc10	52	0.4	28	16	27	9.3	11	168
Acc11	50	0.4	28	21	28	9.4	11	175
Acc12	52	0.4	29	21	28	7.8	10	175
Acc13	58	0.3	30	15	30	8.0	13	153
Acc14	47	0.6	25	16	25	9.7	6	100
Acc15	53	0.3	26	13	25	8.3	9	143
Acc16	50	0.3	29	15	28	9.0	7	141
Acc17	44	0.6	23	14	23	9.3	10	153
Acc18	45	0.3	24	13	23	8.3	10	142
Acc19	40	0.3	26	12	26	8.2	12	139
Acc20	35	0.3	25	13	25	8.8	7	136
Acc21	35	0.3	25	15	25	8.2	9	132
Acc22	24	0.2	23	12	22	8.7	4	121
Acc23	46	0.5	25	16	25	7.9	9	118
Acc24	52	0.6	26	15	26	8.2	8	136
Acc25	42	0.5	27	14	26	9.6	11	166
Acc26	37	0.5	31	13	31	7.2	19	135
Acc27	52	0.4	25	15	25	10.4	11	175
Acc28	52	0.4	29	13	29	9.0	11	151
Acc29	46	0.7	21	12	21	9.3	7	114
Acc30	46	0.6	21	11	20	9.9	8	145
Acc31	50	0.5	21	14	20	9.3	6	128
Acc32	32	0.4	25	14	25	9.3	9	115
Acc33	33	0.5	12	13	12	10.7	9	147
Acc34	49	0.4	20	15	20	11.1	10	132
Acc35	49	0.4	17	9	17	9.9	2	132
Acc36	48	0.4	23	16	23	9.6	10	160
Acc37	38	0.6	25	10	24	10.3	8	155
Acc38	34	0.3	25	10	24	8.8	4	138
Acc39	52	0.6	22	12	22	10.6	7	150
Acc40	46	0.6	19	13	19	10.6	8	137
Acc41	43	0.5	24	11	24	10.4	6	143
Acc42	44	0.5	20	12	30	9.9	10	133
Acc43	43	0.8	23	13	23	11.0	9	142
Acc44	34	0.4	26	14	26	10.6	10	147
Acc45	36	0.6	26	16	26	9.0	17	156
Acc46	39	0.4	26	12	26	8.5	7	141
Acc47	39	0.3	26	15	26	9.7	9	151
Acc48	26	0.4	27	14	28	9.4	5	143

Table 3 continued…

ACC NO.	PLANT HEIGHT (35 DAP)	STEM DIAMETER (CM)	NO. OF NODES/ PLANT	NODE NO. BEARING 1ST FLOWER CLUSTER	NODE NO. BEARING LAST FLOWER CLUSTER	INTER-NODE LENGTH (CM)	NUMBER OF BRANCHES	FINAL PLANT HEIGHT (CM)
Acc49	48	0.6	31	16	31	8.7	19	142
Acc50	40	0.4	30	16	30	9.3	9	151
Acc51	35	0.4	29	16	29	8.7	11	156
Acc52	38	0.4	28	20	28	9.7	10	172
Acc53	48	0.4	27	20	27	9.9	13	166
Acc54	38	0.4	26	20	26	10.4	13	167
Acc55	43	0.4	30	17	30	10.6	10	166
Acc56	32	0.4	26	18	26	8.9	12	146
Acc57	48	0.4	25	20	25	8.0	15	166
Acc58	42	0.4	23	16	21	10.5	10	158
Acc59	38	0.4	31	17	31	10.5	9	162
Acc60	48	0.7	26	17	26	9.1	14	140
Acc61	50	0.6	20	18	23	9.8	12	146
Acc62	48	0.6	20	17	20	8.8	6	150
Acc63	40	0.5	25	13	24	9.5	12	145
Acc64	43	0.6	25	14	24	10.6	10	133
Acc65	48	0.6	22	17	22	9.7	13	143
Acc66	47	0.6	24	18	24	8.1	12	147
Acc67	44	0.5	26	17	26	10.5	10	145
Acc68	40	0.6	27	18	27	9.6	11	153
Acc69	35	0.5	25	15	24	9.5	7	143
Acc70	42	0.5	24	13	24	9.6	8	130
Acc71	47	0.4	29	21	29	9.3	6	180
Acc72	54	0.5	29	21	29	10.1	9	162
Acc73	47	0.3	27	15	27	10.2	7	159
Acc74	47	0.6	23	13	23	10.2	8	141
Acc75	37	0.5	27	13	27	9.8	10	157
Acc76	40	0.5	29	12	19	9.0	6	140
Acc77	48	0.3	27	21	27	10.0	7	159
Acc78	31	0.6	27	14	27	10.1	13	177
Acc79	31	0.5	26	12	26	10.2	13	150
Acc80	50	0.5	26	13	26	9.6	6	160
Acc81	43	0.6	22	13	22	9.9	10	132
Acc82	40	0.5	23	13	23	10.7	14	131
Acc83	22	0.4	28	13	28	10.7	6	158
Acc84	44	0.3	28	13	28	10.7	13	153
Acc85	48	0.6	26	15	26	9.3	13	153
Acc86	35	0.4	22	13	22	9.2	10	143
Acc87	44	0.6	26	13	26	10.2	7	155
Acc88	42	0.6	23	13	23	9.9	13	130
Acc89	20	0.4	26	13	26	10.5	5	143
Acc90	38	0.6	26	14	26	10.1	14	143
Acc91	35	0.6	21	11	21	9.7	10	145
Acc92	47	0.7	31	19	31	10.3	15	175
Acc93	59	0.6	25	15	25	9.4	13	131
Acc94	25	0.4	23	11	24	10.0	6	130
Acc95	29	0.4	22	13	22	10.1	12	132
Acc96	25	0.4	25	12	25	10.7	7	155

Table 3 continued…

ACC NO.	PLANT HEIGHT (35 DAP)	STEM DIAMETER (CM)	NO. OF NODES/ PLANT	NODE NO. BEARING 1ST FLOWER CLUSTER	NODE NO. BEARING LAST FLOWER CLUSTER	INTER-NODE LENGTH (CM)	NUMBER OF BRANCHES	FINAL PLANT HEIGHT (CM)
Acc97	26	0.4	27	14	27	10.2	9	152
Acc98	35	0.5	22	12	22	8.8	8	127
Acc99	42	0.6	21	12	21	9.7	9	116
Acc100	46	0.6	27	16	27	10.5	10	150
Acc101	35	0.4	27	16	27	7.9	6	156
Acc102	31	0.6	27	20	27	8.6	8	153
Acc103	30	0.4	25	16	25	9.4	11	115
Acc104	52	0.7	24	17	24	9.8	15	130
Acc105	20	0.4	26	10	26	8.9	6	135
Acc106	44	0.6	29	21	29	9.1	11	150
Acc107	41	0.4	28	20	28	10.4	8	150
Acc108	32	0.5	25	17	25	9.2	10	143
Acc109	54	0.5	27	18	27	9.1	6	158
Acc110	25	0.2	25	12	25	10.3	3	175
Acc111	58	0.4	32	18	32	8.8	10	181
Acc112	41	0.6	21	17	21	8.9	15	150
Acc113	41	0.6	22	16	23	8.9	10	160
Acc114	42	0.7	26	21	26	10.2	14	133
Acc115	43	0.4	26	20	26	9.6	12	143
Acc116	43	0.5	29	14	29	8.6	14	143
Acc117	37	0.6	29	19	27	10.4	17	176
Acc118	47	0.6	25	20	25	9.9	8	154
Acc119	45	0.5	28	13	28	10.4	13	154
Acc120	46	0.5	31	14	31	8.1	18	147
Acc121	48	0.6	19	19	19	9.8	15	145
Acc122	44	0.8	22	18	22	10.1	10	147
Acc123	42	0.4	27	17	27	8.4	7	153
Acc124	45	0.5	29	23	28	9.9	10	157
Acc125	43	0.5	24	13	24	10.4	8	150
Acc126	41	0.6	22	13	22	9.2	9	125
Acc127	41	0.5	17	8	17	10.4	4	126
Acc128	45	0.7	16	9	16	9.9	3	124
Acc129	46	0.6	19	9	19	10.5	4	131
Acc130	44	0.6	19	8	19	10.0	3	114
Acc131	36	0.6	29	14	29	7.6	6	140
Acc132	32	0.5	19	10	19	10.4	7	131
Acc133	24	0.4	27	13	27	10.5	4	146
Acc134	30	0.4	26	12	26	9.5	8	145
Acc135	38	0.5	31	17	31	10.0	7	165
Acc136	37	0.6	31	15	31	10.3	8	172
Acc137	38	0.5	26	14	26	9.8	13	193
Acc138	26	0.5	29	17	29	9.7	11	183
Acc139	26	0.5	23	14	22	10.3	11	160
Acc140	32	0.5	30	15	30	10.4	8	167
Acc141	33	0.5	24	12	24	10.4	10	165
Acc142	23	0.4	26	14	26	10.3	5	154
Acc143	37	0.6	18	8	17	9.9	5	146
Acc144	51	0.6	18	8	18	9.7	2	136

Table 3 continued…

ACC NO.	PLANT HEIGHT (35 DAP)	STEM DIAMETER (CM)	NO. OF NODES/ PLANT	NODE NO. BEARING 1ST FLOWER CLUSTER	NODE NO. BEARING LAST FLOWER CLUSTER	INTER-NODE LENGTH (CM)	NUMBER OF BRANCHES	FINAL PLANT HEIGHT (CM)
Acc145	33	0.5	22	12	22	9.4	8	140
Acc146	55	0.4	23	14	23	10.0	6	131
Acc147	41	0.5	24	9	24	10.0	6	127
Acc148	47	0.4	21	12	21	9.2	9	130
Acc149	37	0.5	18	14	18	10.4	7	170
Acc150	45	0.6	21	14	21	9.6	7	145
Acc151	46	0.6	18	8	18	10.1	2	140
Acc152	45	0.7	24	14	24	9.5	6	147
Acc153	51	0.6	25	15	25	8.0	3	138
Acc154	32	0.5	25	13	24	8.9	5	152
TOTAL	6,317	76.1	3,836	2,241	3,817	1,463.3	1,401	22,606
Variation	73.69	0.01	12.66	10.2	12.76	0.93	12.08	264.31
Standard Variation	8.58	0.12	3.56	3.19	3.57	0.97	3.47	16.26
MEAN	41.019	0.494	24.909	14.552	24.786	9.502	9.097	146.792

Table 4. Pod and seed characters of 154 garden pea accessions

ACC NO.	POD LENGTH (CM)	POD WIDTH (CM)	NUMBER. OF POD CLUSTER/PLANT	NUMBER OF PODS/CLUSTER	NUMBER OF SEEDS/POD
Acc1	7.9	1.4	51	1	6
Acc2	6.6	1.3	52	1	4
Acc3	6.4	1.3	50	2	4
Acc4	5.7	1.6	88	1	3
Acc5	5.4	1.3	32	1	5
Acc6	7.6	1.5	48	2	5
Acc7	5.5	1.3	38	1	4
Acc8	7.3	1.6	42	2	5
Acc9	7.4	1.6	35	2	4
Acc10	6.5	1.5	61	2	4
Acc11	6.5	1.4	46	2	3
Acc12	6.6	1.3	62	2	4
Acc13	6.9	1.4	60	1	4
Acc14	7.4	1.5	23	2	3
Acc15	7.3	1.4	56	1	7
Acc16	7.1	1.4	70	1	7
Acc17	8.0	1.7	64	1	4
Acc18	6.3	1.3	52	1	5
Acc19	6.7	1.3	82	1	5
Acc20	6.8	1.3	35	1	6
Acc21	6.7	1.3	54	1	7
Acc22	6.0	1.3	28	1	5
Acc23	7.1	1.3	67	1	7
Acc24	7.2	1.5	44	2	5
Acc25	7.7	1.6	58	1	4
Acc26	5.1	1.1	30	2	5
Acc27	5.9	1.3	56	2	6
Acc28	6.6	1.4	59	2	3
Acc29	7.5	1.4	22	1	3
Acc30	7.7	1.5	53	1	4
Acc31	7.5	1.4	45	1	3
Acc32	6.1	1.3	42	2	6
Acc33	8.2	1.4	52	1	4
Acc34	8.0	1.5	37	1	7
Acc35	7.9	1.5	27	2	5
Acc36	5.9	1.2	37	2	5
Acc37	6.8	1.4	63	1	5
Acc38	6.5	1.1	31	1	5
Acc39	7.7	1.4	63	1	8
Acc40	8.0	1.5	47	1	8
Acc41	7.9	1.4	42	1	7
Acc42	6.8	1.4	39	1	6
Acc43	7.6	1.4	45	1	6
Acc44	6.6	1.2	37	1	7
Acc45	7.1	1.5	52	2	5
Acc46	6.7	1.5	53	1	8
Acc47	6.9	1.4	47	1	6
Acc48	6.0	1.3	45	1	5
Acc49	8.3	1.9	49	2	7

Table 4 continued …

ACC NO.	POD LENGTH (CM)	POD WIDTH (CM)	NUMBER. OF POD CLUSTER/PLANT	NUMBER OF PODS/CLUSTER	NUMBER OF SEEDS/POD
Acc50	6.6	1.4	39	1	6
Acc51	6.8	1.2	59	1	5
Acc52	6.5	1.4	62	2	4
Acc53	5.6	1.4	45	2	4
Acc54	5.2	1.4	44	2	4
Acc55	6.0	1.6	39	2	3
Acc56	6.5	1.6	37	2	3
Acc57	6.8	1.5	41	2	2
Acc58	6.2	1.5	36	2	4
Acc59	6.9	1.5	46	2	5
Acc60	6.6	1.5	40	2	6
Acc61	6.9	1.5	36	2	5
Acc62	7.2	1.5	28	2	5
Acc63	7.1	1.6	42	2	5
Acc64	6.9	1.5	48	1	5
Acc65	7.3	1.5	40	2	4
Acc66	6.8	1.4	42	2	5
Acc67	6.8	1.4	45	2	5
Acc68	6.6	1.4	59	2	5
Acc69	6.8	1.4	39	1	6
Acc70	6.9	1.4	48	1	5
Acc71	6.5	1.4	39	2	3
Acc72	7.1	1.5	28	2	4
Acc73	7.3	1.6	20	2	5
Acc74	7.4	1.6	40	1	4
Acc75	7.0	1.6	71	1	4
Acc76	7.0	1.4	45	1	6
Acc77	6.9	1.5	30	1	4
Acc78	6.2	1.5	32	2	3
Acc79	7.5	1.5	41	2	5
Acc80	6.8	1.6	34	1	4
Acc81	7.2	1.4	45	2	6
Acc82	6.4	1.5	61	1	6
Acc83	6.0	1.3	39	1	4
Acc84	7.3	1.5	45	1	5
Acc85	6.5	1.5	55	2	5
Acc86	7.2	1.5	41	1	5
Acc87	7.0	1.5	70	1	5
Acc88	7.1	1.4	54	1	4
Acc89	6.5	1.4	37	1	6
Acc90	7.1	1.5	76	1	5
Acc91	7.4	1.5	71	1	5
Acc92	6.5	1.7	60	1	4
Acc93	7.2	1.5	75	1	5
Acc94	5.8	1.3	31	1	4
Acc95	7.1	1.5	56	1	7
Acc96	7.1	1.6	67	1	7
Acc97	6.0	1.5	63	1	3
Acc98	6.5	1.3	38	1	7
Acc99	6.8	1.5	45	1	3

Table 4 continued …

ACC NO.	POD LENGTH (CM)	POD WIDTH (CM)	NUMBER. OF POD CLUSTER/PLANT	NUMBER OF PODS/CLUSTER	NUMBER OF SEEDS/POD
Acc100	6.4	1.6	36	2	4
Acc101	7.0	1.5	22	2	4
Acc102	6.7	1.5	28	2	5
Acc103	6.4	1.5	39	1	5
Acc104	7.2	1.6	40	1	6
Acc105	6.4	1.4	21	2	5
Acc106	6.8	1.5	42	1	3
Acc107	6.8	1.5	27	2	5
Acc108	7.2	1.5	36	1	7
Acc109	7.7	1.8	32	2	4
Acc110	7.3	1.7	25	1	5
Acc111	6.5	1.5	37	1	3
Acc112	7.0	1.5	41	2	3
Acc113	7.1	1.6	51	2	5
Acc114	7.3	1.6	46	2	5
Acc115	6.7	1.5	27	2	6
Acc116	7.0	1.4	34	2	6
Acc117	5.8	1.5	75	2	7
Acc118	6.3	1.5	43	2	4
Acc119	6.6	1.6	66	2	6
Acc120	6.7	1.6	54	1	3
Acc121	6.8	1.5	38	2	3
Acc122	6.9	1.6	35	2	6
Acc123	6.9	1.5	41	2	5
Acc124	6.8	1.4	35	2	5
Acc125	7.7	1.6	54	1	8
Acc126	7.4	1.5	36	1	4
Acc127	7.7	1.4	37	2	5
Acc128	7.5	1.4	23	1	5
Acc129	7.2	1.4	34	1	5
Acc130	7.3	1.4	24	1	6
Acc131	6.4	1.4	41	2	6
Acc132	6.6	1.5	69	2	5
Acc133	7.0	1.6	46	1	4
Acc134	6.7	1.5	36	1	3
Acc135	7.9	1.6	69	1	4
Acc136	7.8	1.6	53	1	5
Acc137	7.8	1.7	63	1	4
Acc138	7.2	1.7	85	1	3
Acc139	7.4	1.5	71	1	3
Acc140	7.8	1.6	56	1	4
Acc141	7.9	1.5	92	1	5
Acc142	8.8	1.6	45	1	4
Acc143	7.8	1.5	33	1	3
Acc144	7.1	1.2	35	2	5
Acc145	7.6	1.5	38	1	7
Acc146	7.5	1.5	46	1	4
Acc147	7.3	1.4	41	1	3
Acc148	7.0	1.5	51	1	5
Acc149	7.5	1.4	48	1	7

Table 4 continued …

ACC NO.	POD LENGTH (CM)	POD WIDTH (CM)	NUMBER. OF POD CLUSTER/PLANT	NUMBER OF PODS/CLUSTER	NUMBER OF SEEDS/POD
Acc150	7.1	1.5	37	1	5
Acc151	7.0	1.4	22	1	5
Acc152	6.9	1.6	31	2	4
Acc153	6.5	1.4	32	2	3
Acc154	6.8	1.6	49	1	5
TOTAL	1,067.8	225.9	7,063	218	747
Variance	0.39	0.02	210.07	0.24	1.64
Standard Variation	0.62	0.12	14.49	0.49	1.28
MEAN	6.934	1.467	45.864	1.416	4.851

Qualitative Characters

Leaf color. All the garden pea accessions characterized had green leaf as shown in Table 5.

Flower color. Table 5 presents the color of flowers observed in the garden pea accession characterized 90 % had purple flower color, 9 % had white flower color and only one accessions had pink flowers.

Pod color. As presented in Table 5, 76 % of the garden pea accessions had dark green pods while 24 % had green pods.

Pod shape. The pod shape of the garden pea accession varied from straight to curved. Sixty six percent of the accessions had curved pods while 24 % had straight pods (Table 5).

Stringiness of pod. All garden pea accessions were observed to be stringless as presented in Table 5.

Waxiness of pod. The presence of wax in the pods was observed in all the garden pea accessions as noted in Table 5.

Seed color. Table 5 shows that the seed color of the garden pea accession ranged from light green, to green, to dark green, to dotted green and to cream. It was observed that the accessions with white flower color produced cream seeds while the accessions with purple flowers produced either dotted green, light green and dark green seeds.

Seed shape. Eighty three percent (83 %) of the garden pea accessions had wrinkled seeds while 17 % had round seeds as shown in Table 5.

Table 5. Qualitative characters of 154 garden pea accessions

ACC NO.	LEAF COLOR	FLOWER COLOR	POD COLOR	POD SHAPE	STRINGINESS OF POD	WAXINESS OF POD	SEED COLOR	SEED SHAPE
Acc1	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc2	Green	White	Green	Straight	Stringless	Present	Green	Wrinkled
Acc3	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc4	Green	Purple	Dark green	Curve	Stringless	Present	Green	Wrinkled
Acc5	Green	White	Green	Straight	Stringless	Present	Green	Wrinkled
Acc6	Green	Purple	Dark green	Straight	Stringless	Present	Green	Wrinkled
Acc7	Green	Purple	Dark green	Curve	Stringless	Present	Light green	Round
Acc8	Green	Purple	Dark green	Curve	Stringless	Present	Dotted green	Wrinkled
Acc9	Green	Purple	Dark green	Curve	Stringless	Present	Light green	Wrinkled
Acc10	Green	Purple	Dark green	Curve	Stringless	Present	Light green	Wrinkled
Acc11	Green	Purple	Dark green	Curve	Stringless	Present	Light green	Round
Acc12	Green	Purple	Dark green	Curve	Stringless	Present	Light green	Round
Acc13	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc14	Green	Purple	Green	Straight	Stringless	Present	Cream	Round
Acc15	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc16	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc17	Green	Purple	Dark green	Curve	Stringless	Present	Dotted green	Wrinkled

Table 5 continued …

ACC NO.	LEAF COLOR	FLOWER COLOR	POD COLOR	POD SHAPE	STRINGINESS OF POD	WAXINESS OF POD	SEED COLOR	SEED SHAPE
Acc18	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc19	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc20	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc21	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc22	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc23	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc24	Green	Purple	Dark green	Curve	Stringless	Present	Dotted green	Wrinkled
Acc25	Green	Purple	Dark green	Curve	Stringless	Present	Dotted green	Wrinkled
Acc26	Green	White	Green	Straight	Stringless	Present	Cream	Round
Acc27	Green	Purple	Green	Straight	Stringless	Present	Dotted green	Wrinkled
Acc28	Green	Purple	Dark green	Curve	Stringless	Present	Dotted green	Wrinkled
Acc29	Green	Purple	Green	Straight	Stringless	Present	Dotted green	Wrinkled
Acc30	Green	Purple	Dark green	Curve	Stringless	Present	Dotted green	Wrinkled
Acc31	Green	Purple	Dark green	Curve	Stringless	Present	Dotted green	Wrinkled
Acc32	Green	Purple	Dark green	Curve	Stringless	Present	Green	Wrinkled
Acc33	Green	Purple	Green	Straight	Stringless	Present	Green	Wrinkled
Acc34	Green	Purple	Green	Curve	Stringless	Present	Dotted green	Wrinkled
Acc35	Green	Purple	Dark green	Straight	Stringless	Present	Dotted green	Round
Acc36	Green	Purple	Green	Curve	Stringless	Present	Dotted green	Round
Acc37	Green	Purple	Green	Straigh t	Stringless	Present	Dotted green	Wrinkled
Acc38	Green	Purple	Dark green	Straight	Stringless	Present	Dotted green	Wrinkled
Acc39	Green	Purple	Dark green	Straight	Stringless	Present	Dotted green	Wrinkled
Acc40	Green	Purple	Dark green	Straight	Stringless	Present	Green	Wrinkled
Acc41	Green	Purple	Green	Straight	Stringless	Present	Green	Wrinkled
Acc42	Green	Purple	Green	Straight	Stringless	Present	Green	Wrinkled

Table 5 continued …

ACC NO.	LEAF COLOR	FLOWER COLOR	POD COLOR	POD SHAPE	STRINGINESS OF POD	WAXINESS OF POD	SEED COLOR	SEED SHAPE
Acc43	Green	Purple	Green	Straight	Stringless	Present	Green	Wrinkled
Acc44	Green	White	Dark green	Straight	Stringless	Present	Cream	Round
Acc45	Green	Purple	Green	Curve	Stringless	Present	Green	Wrinkled
Acc46	Green	Purple	Green	Straight	Stringless	Present	Green	Wrinkled
Acc47	Green	Purple	Green	Straight	Stringless	Present	Green	Wrinkled
Acc48	Green	White	Dark green	Straight	Stringless	Present	Cream	Round
Acc49	Green	Purple	Green	Curve	Stringless	Present	Green	Wrinkled
Acc50	Green	Purple	Green	Straight	Stringless	Present	Green	Wrinkled
Acc51	Green	Purple	Green	Straight	Stringless	Present	Green	Wrinkled
Acc52	Green	Purple	Green	Curve	Stringless	Present	Green	Wrinkled
Acc53	Green	Purple	Green	Curve	Stringless	Present	Green	Wrinkled
Acc54	Green	Purple	Green	Curve	Stringless	Present	Light green	Round
Acc55	Green	Purple	Green	Curve	Stringless	Present	Light green	Round
Acc56	Green	Purple	Green	Curve	Stringless	Present	Light green	Round
Acc57	Green	Purple	Green	Curve	Stringless	Present	Light green	Wrinkled
Acc58	Green	Purple	Green	Curve	Stringless	Present	Light green	Wrinkled
Acc59	Green	Purple	Green	Curve	Stringless	Present	Light green	Wrinkled
Acc60	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc61	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc62	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc63	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc64	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc65	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc66	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled

Table 5 continued …

ACC NO.	LEAF COLOR	FLOWER COLOR	POD COLOR	POD SHAPE	STRINGINESS OF POD	WAXINESS OF POD	SEED COLOR	SEED SHAPE
Acc67	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc68	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc69	Green	White	Green	Straight	Stringless	Present	Cream	Wrinkled
Acc70	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc71	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc72	Green	Purple	Dark green	Curve	Stringless	Present	Green	Wrinkled
Acc73	Green	Purple	Dark green	Curve	Stringless	Present	Green	Wrinkled
Acc74	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc75	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc76	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc77	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc78	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc79	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc80	Green	Purple	Dark green	Curve	Stringless	Present	Green	Wrinkled
Acc81	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc82	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc83	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc84	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc85	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc86	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc87	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc88	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc89	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc90	Green	Purple	Dark green	Straight	Stringless	Present	Green	Wrinkled
Acc91	Green	Purple	Dark green	Curve	Stringless	Present	Green	Wrinkled

Table 5 continued …

ACC NO.	LEAF COLOR	FLOWER COLOR	POD COLOR	POD SHAPE	STRINGINESS OF POD	WAXINESS OF POD	SEED COLOR	SEED SHAPE
Acc92	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc93	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc94	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc95	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc96	Green	Purple	Dark green	Curve	Stringless	Present	Green	Wrinkled
Acc97	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc98	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc99	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc100	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc101	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc102	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc103	Green	Purple	Dark green	Curve	Stringless	Present	Green	Wrinkled
Acc104	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc105	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc106	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc107	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc108	Green	Purple	Dark green	Curve	Stringless	Present	Green	Wrinkled
Acc109	Green	Purple	Dark green	Curve	Stringless	Present	Green	Wrinkled
Acc110	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc111	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc112	Green	Purple	Dark green	Straight	Stringless	Present	Green	Wrinkled
Acc113	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc114	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc115	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc116	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled

Table 5 continued …

ACC NO.	LEAF COLOR	FLOWER COLOR	POD COLOR	POD SHAPE	STRINGINESS OF POD	WAXINESS OF POD	SEED COLOR	SEED SHAPE
Acc117	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc118	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc119	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc120	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc121	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc122	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc123	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc124	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc125	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc126	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc127	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc128	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc129	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc130	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc131	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc132	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc133	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc134	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc135	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc136	Green	Pink white	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc137	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc138	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc139	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc140	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc141	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled

Table 5 continued …

ACC NO.	LEAF COLOR	FLOWER COLOR	POD COLOR	POD SHAPE	STRINGINESS OF POD	WAXINESS OF POD	SEED COLOR	SEED SHAPE
Acc142	Green	Purple	Dark green	Curve	Stringless	Present	Dark green	Wrinkled
Acc143	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc144	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc145	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc146	Green	Purple	Dark green	Straight	Stringless	Present	Green	Wrinkled
Acc147	Green	Purple	Dark green	Straight	Stringless	Present	Green	Wrinkled
Acc148	Green	Purple	Dark green	Straight	Stringless	Present	Green	Wrinkled
Acc149	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc150	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc151	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc152	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc153	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled
Acc154	Green	Purple	Dark green	Straight	Stringless	Present	Dark green	Wrinkled

Out of the 154 accessions characterized 20 were identified promising materials for commercialization because of their prolificacy and pod quality such as Accs 3, 5, 6, 7, 8, 13,23, 25, 43, 109, 129, 130, 131, 147, 148, 149, 150, 151, 153 and 54.

B. Diversity Indices (H`)

The computed diversity indices for the quantitative characters ranged from 0.63 (number of days from flowering to pod setting) to 0.99 (number of flower per cluster) with mean diversity of 0.87 (Table 6). Number of days from emergence to first flowering, leaf width, number of nodes per plant, node number bearing last flower cluster, internode length and pod length had a diversity index of 0.87. Only five

characters had H` below 0.87 which range from 70 to 85, such as number of days from emergence to last flowering (0.84), number of days from pod setting to maturity (0.85), number of leaflet per plant (0.70), stem diameter (0.85) and pod width (0.82). It was also observed that most of the characters measured had high H' indicating high variability present within the collection.

Table 7 presents the diversity indices for qualitative characters gathered from the 154 accessions of garden pea. Diversity indices ranged from 0.34 to 0.99. The diversity value showed low variation for the flower color having 0.34 H'. Medium variation for seed shape (0.66) while high variation was noted for pod color (0.81), pod shape (0.99) and seed color (0.86).

Pooling diversity values for both the quantitative and qualitative characters gave an overall mean diversity index of 0.80 in the collection. This implies that variability among the existing accession is sufficient already to select parents to be involved in hybridization program to develop desirable variety of garden pea.

C. Cluster Analysis

The cluster analysis conducted on the 28 characters of the 154 garden pea accessions (23 quantitative characters and five qualitative characters) formed 14 distinct clusters, at a dissimilarity coefficient of 14.73 (Figure 1). There were eight single character cluster. There were six two to six characters cluster such as cluster 1 to 4, 8, 11, 13 and 14. The presence of eight single characters cluster indicated distinctiveness of the characters. For two to six character clusters could due to the similarities of character within the accessions.

Cluster analysis for 154 accessions of garden pea resulted in the formation of a tree with 41 clusters at a dissimilarity coefficient of 0.50. There were 14 single accession clusters, 10 two-accession clusters, 14 3 to 6 accession clusters and three 11 to 15 accession clusters (Figure 2). Clusters with one accession, signifies distinctness of the accession from the other single accession clusters and other clusters with 2 or more accessions. The existence of clusters with few or more accessions indicated the presence of high variation among clusters of the accessions studied and high similarities of accessions within a cluster.

Table 6. Computed diversity indices (H`) for the quantitative characters

CHARACTER	H'
Number of days from planting to seed emergence	0.90
Number of days from emergence to first flowering	0.87
Number of days from emergence to last flowering	0.84
Number of days from pod setting to maturity	0.85
Number of leaflet per plant	0.70
Leaf length	0.95
Leaf width	0.87
Tendril length	0.91
Plant height at 35DAP	0.95
Stem diameter	0.85
Number of nodes per plant	0.87
Number of node bearing first flower cluster	0.88
Number of node bearing last flower cluster	0.87
Internode length	0.87
Number of branches	0.91
Final plant height	0.91
Number of flower per cluster	0.99
Pod length	0.87
Pod width	0.82
Number of pod cluster per plant	0.93
Number of pods per cluster	0.98
Number of seeds per pod	0.89
Mean diversity index	0.87

Table 7. Computed diversity indices (H`) for the qualitative characters

CHARACTERS	H’
Flower color	0.34
Pod color	0.81
Pod shape	0.99
Seed color	0.86
Seed shape	0.66
Mean diversity index	0.73

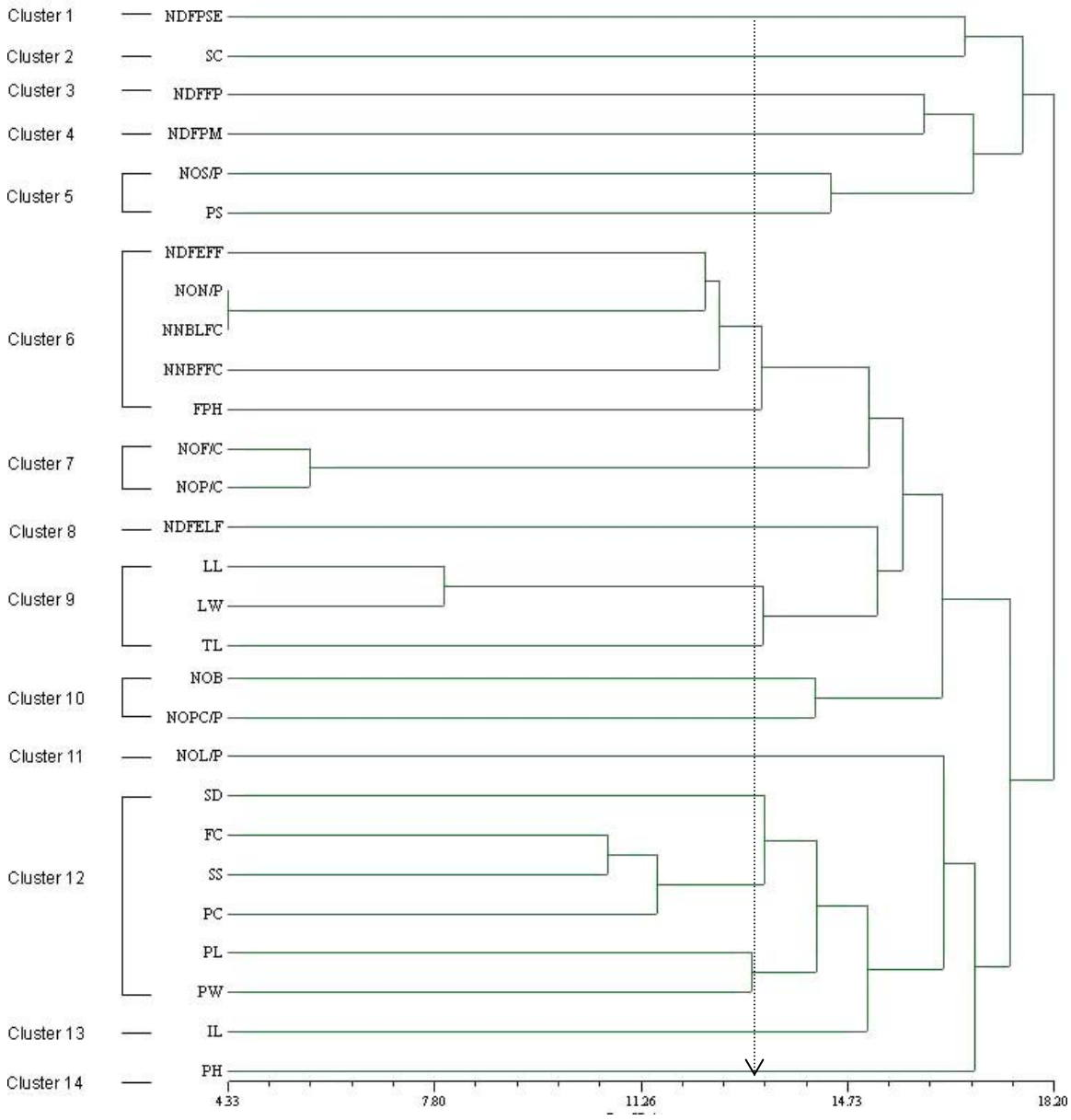

Figure 1. Phenogram produced from cluster analysis of the 28 characters of garden pea using NTSys v.2.1

LEGEND:

NDFPSE -	Number of days from sowing to emergence	LL-	Leaf length
SC-	Seed color	LW-	Leaf width
NDFFP-	Number of days from flowering to pod setting	TL-	Tendril length
NDFPM-	Number of days from flowering to pod maturity	NOB-	Number of branches
NOS/P-	Number of seeds/ pod	NOPC/P-	Number of pod cluster/plant
PS-	Pod shape	NOL/P-	Number of leaflet/plant
NDFEFF-	Number of days from emergence to first flowering	SD-	Stem diameter
NON/P-	Number of nodes/plant	FC-	Flower color
NNBLFC-	Number of nodes bearing last flower cluster	SS-	Seed shape
NNBFFC-	Number of nodes bearing 1st flower cluster	PC-	Pod color
FPH-	Final plant height	PL-	Pod length
NOF/C-	Number of flower/cluster	PW-	Pod width
NOP/C-	Number of pod/cluster	IL-	Internode length
NDFELF-	Number of days from emergence to last flowering	PH-	Plant height at 35 DAP

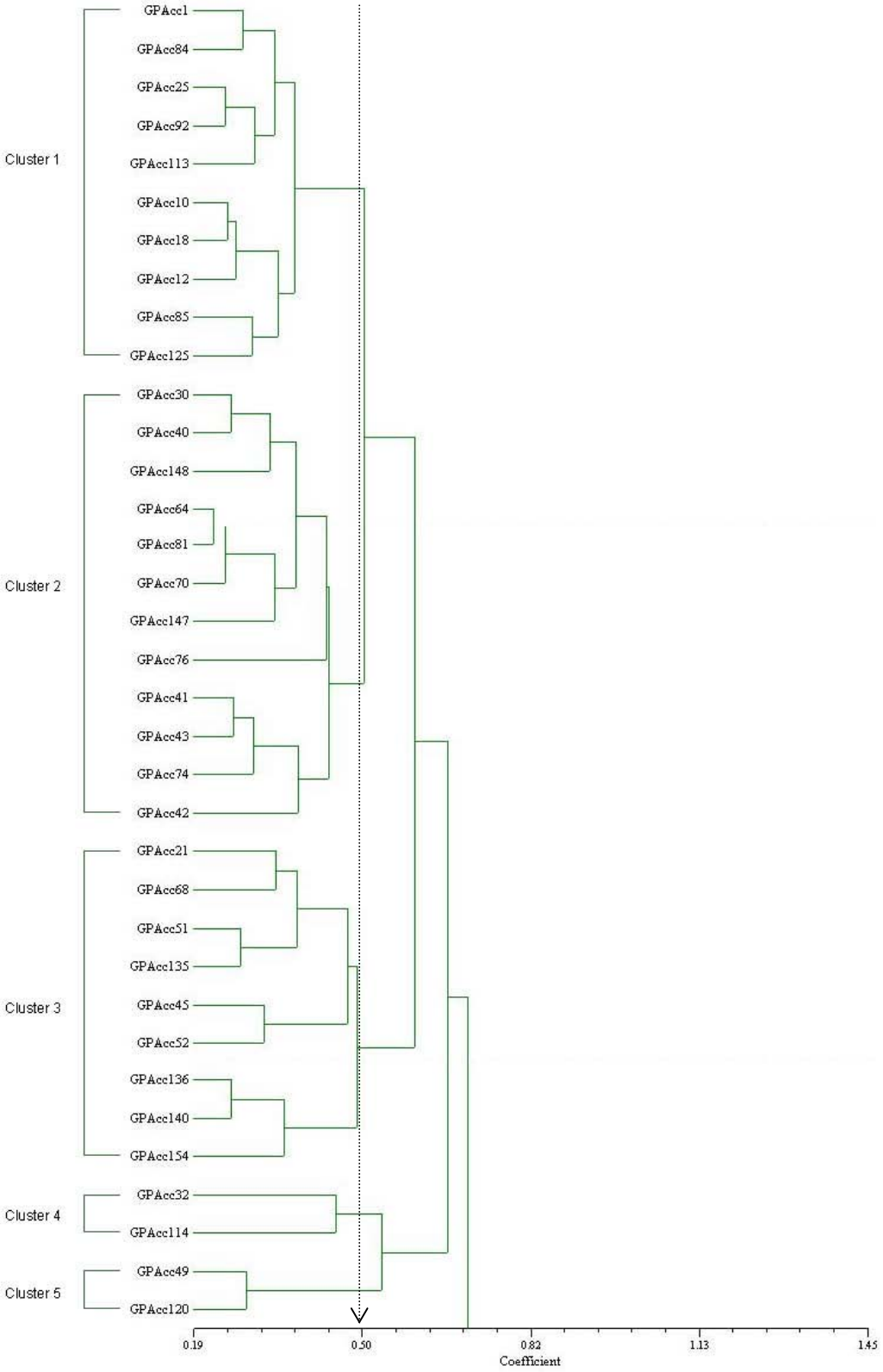

Figure 2. Phenogram produced from cluster analysis of the 154 garden pea accessions using 28 characters NTSys v.2.1

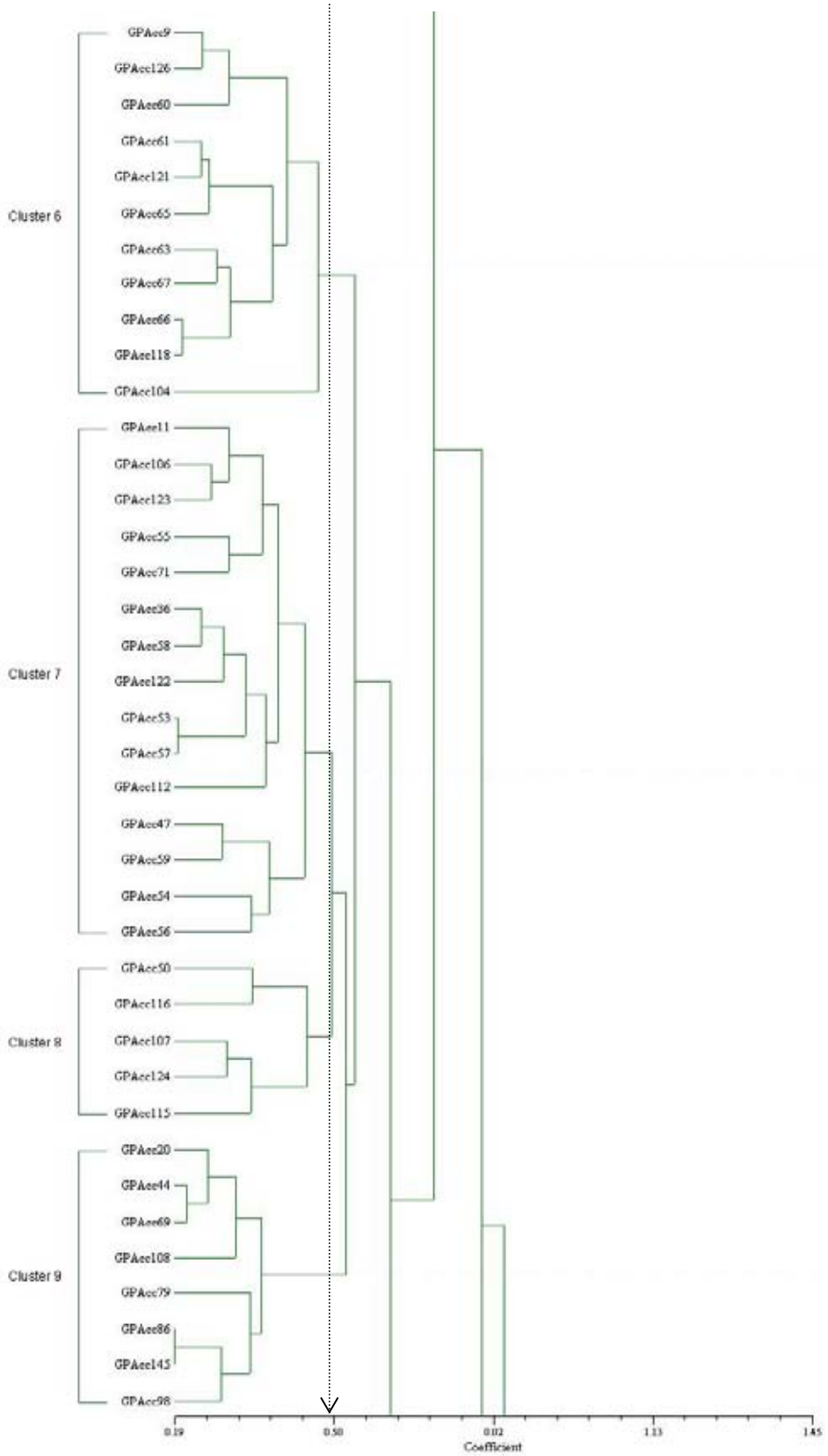

Figure 2. Continued…

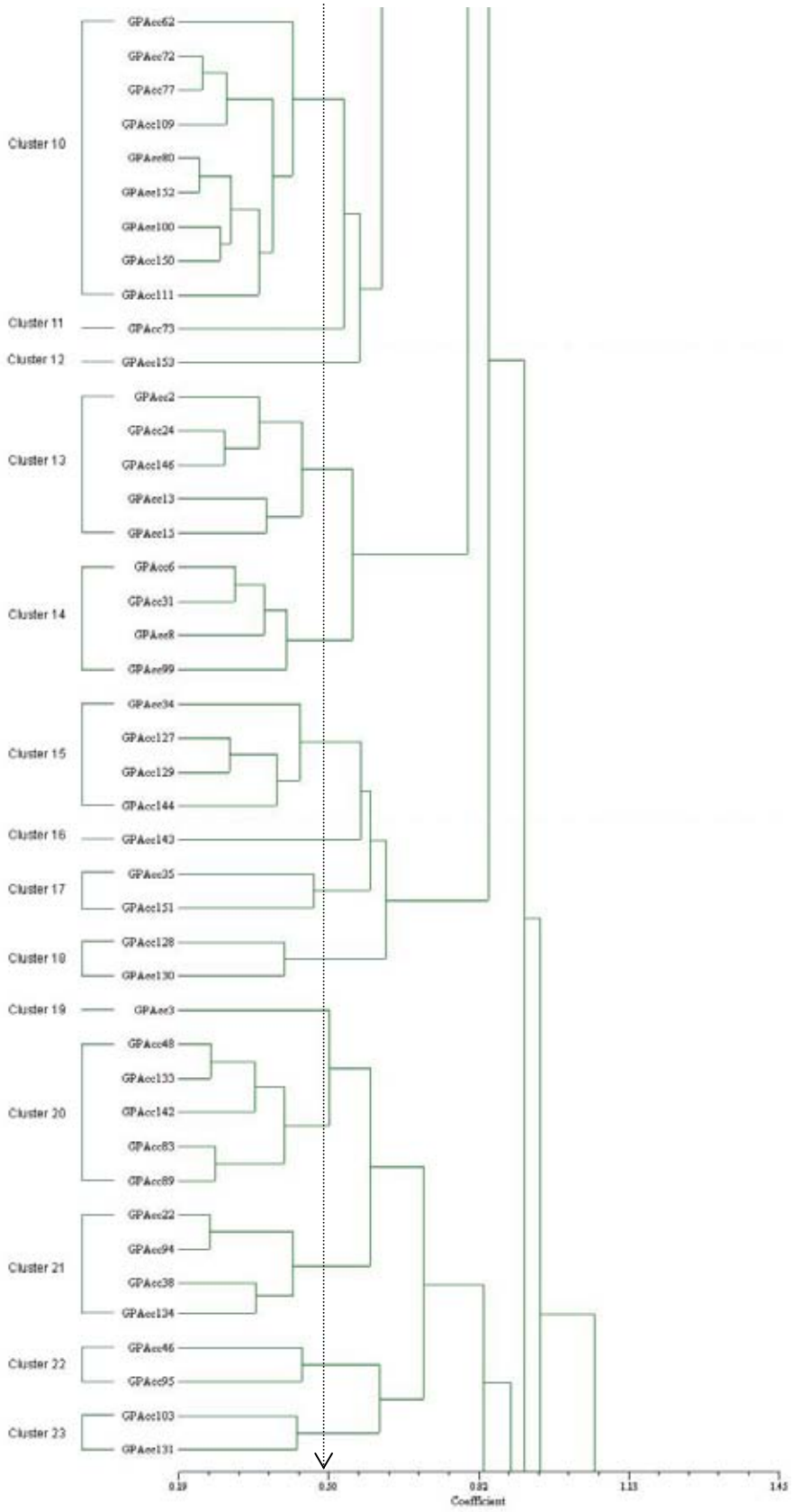

Figure 2. Continued…

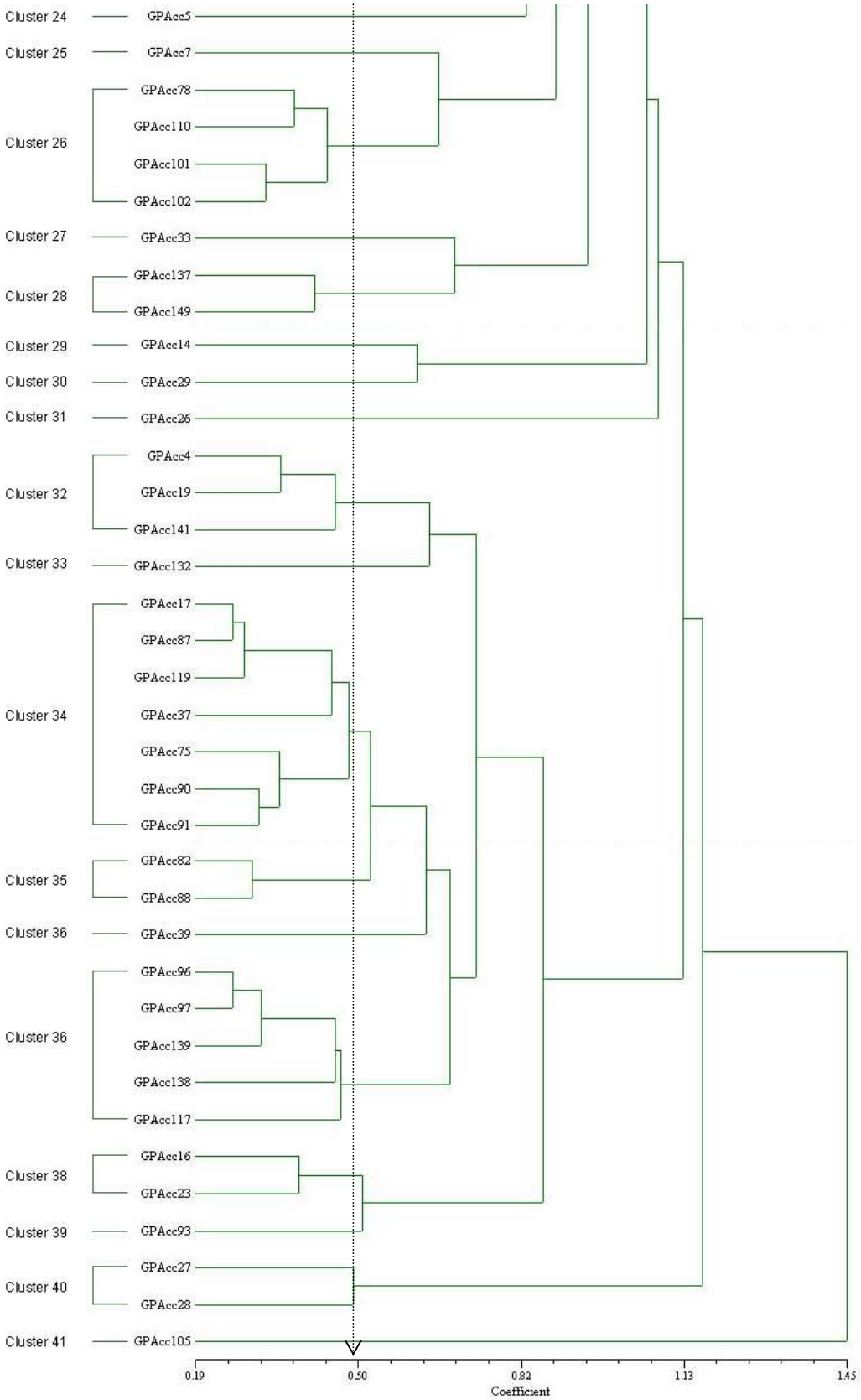

Figure 2. Continued…

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The 154 accessions of garden pea were characterized to estimate variation among them through diversity and cluster analysis.

The 154 accessions of garden pea observed in this study emerged in 5 to 7 days after planting, bore flowers from 54 to 86 days after emergence, took three to nine days from flowering to pod setting and 27 to 47 days from pod setting to seed maturity.

The leaflet length varied from 4.1 to 7.6 cm and width ranged from 3.1 to 7.5 cm. Tendril length measured from 3.8 to 8.9 cm. Eighty percent (80 %) of the accessions had only one flower per cluster and the 20 % had two flowers per cluster. Plant height at 35 DAP ranged from 35 to 59 cm while stem diameter ranged from 0.40 to 0.60 cm only. The number of nodes per plant recorded ranged from 12 to 32 and the first flower was located on the 8th to 21st node from the base of the plant. The last flower developed on the 12th to 32nd node. Internode length measured from 4.7 to 11.1 cm. There were 2 to 18 branches noted per plant. The final plant height varied from 100 to 193 cm.

The pod length of the 154 accessions ranged from 5.1 to 8.8 cm while pod width measured from 1.3 to 15 cm. There were 20 to 92 pod clusters per plant noted among the 154 accessions studied. The number of pods per cluster was either 1 or 2 only. There were 2 to 8 seeds per pod that developed per accession.

In terms of quantitative characters observed in this study, the 154 accessions of garden pea had green leaves, 90 % had purple flowers and 9 % had white flower. Only 1 % had pink flowers. Pod color varied from green to dark with straight to curved shape. All of the accessions had stringless and waxy pods. The seed color varied from light

green to dark green to dotted green to cream. Eighty-three percent (83 %) of the accessions had wrinkled seed and 17 % had round seeds.

Out of the 154 accessions observed, 20 were identified promising materials for commercialization because of the prolificacy and pod quality such as accs 3, 5, 6, 7, 8, 13,23, 25, 43, 109, 129, 130, 131, 147, 148, 149, 150, 151, 153 and 54.

Results on diversity analysis, revealed high variations within the collection of accessions at BSU-IPB HCRS. The computed diversity indices (H`) for the quantitative characters ranged from 0.63 (number of days from flowering to pod setting) to 0.99 (number of flower per cluster) with a mean diversity index of 0.87. Among quantitative characters, five characters had lower than 0.87 H` which ranged from 0.70 to 0.85 H`. The diversity indices for qualitative characters gathered from 154 accessions ranged from 0.34 to 0.99 H`. The H` 0.34 indicated low variation for flower color. Medium variation for seed shape (0.66) was observed while the rest of qualitative characters had high variation with a mean of 0.73 H`. Pooling of diversity indices for all the characters observed gave an overall mean diversity index of 0.80 an indication of high variation within the collection.

Cluster analysis for the 28 characters formed 14 distinct clusters at the dissimilarity coefficient of 14.73. There were 8 single character clusters and six 2 to 6 character clusters. This indicated that characters with single character clusters was distinct from each other and from clusters 2 or more characters. Cluster analysis of 154 accessions of garden pea resulted in the formation of a tree with 41 clusters at a dissimilarity coefficient of 0.50. There were 14 single accession clusters, 10 two accession clusters and 17 13 to 15 accession clusters. Clusters with one accession,

signified distinctness from the other single accession clusters. In addition, existence of clusters with three or more accessions indicated the presence of high variation among clusters of the accessions studied and high similarities of accessions within a cluster.

Conclusion

The 154 accessions differed in the characters observed in this study. Twenty accessions were selected and identified promising materials for commercialization because of their prolificacy and pod quality namely accs 3, 5, 6, 7, 8, 13, 23, 25, 43, 109, 129, 130, 131, 147, 148, 149, 150, 151, 153 and 54.

The computed diversity indices (H`) for the quantitative characters ranged from 0.63 to 0.99 with a mean diversity indices of 0.87. Five characters has lower than 0.87 H` which ranged from 0.70 to 0.85 H`. Diversity indices for qualitative characters ranged from 0.34 to 0.99 H` with a mean 0.73 H`. The 0.34 H` indicated low variation and medium variation for 0.66 H` was observed while the rest of quantitative characters had high variation. Pooling of diversity indices for all the characters observed gave an overall diversity of 0.80 and indication of high variation with in the collection.

The high diversity indices indicate the existence of high variation within the collection based on the quantitative and qualitative characters measured. The high variation present among the accessions studied indicates that potential parents with desirable characters for breeding program could be selected and identified.

Cluster analysis revealed how diversity is partitioned with in the different group produced among characters. The 28 characters formed 14 distinct clusters at the dissimilarity coefficient of 14.73. This indicated that characters with single character clusters were distinct from each other and from cluster with 2 or more characters. Cluster

analysis of 154 accessions of garden pea resulted in a formation of a tree with 41 clusters at a dissimilarity coefficient of 0.50 cluster with one accession, signified distinctness from the other single accession clusters. In addition, the existence of clusters with few or more accessions indicated the presence of high variation among clusters of the accessions studied and high similarities of accessions within a cluster.

Recommendation

Selection among the accessions studied based on characterization done is recommended for better garden pea production because of their prolificacy and pod quality

The high variation found in characters measured in this study among accessions in the collection could be used to start a breeding program and for further evaluation and selection to release new variety for commercial production of garden pea.

Although results of the study indicated high harvest indices (H`) for most characters, it is still recommended that characters having lower H` namely flower color and seed shaped should be the focus in the future collection trip in collecting garden pea varieties or materials.

LITERATURE CITED

ARBIZU, C., R. BLAS, M. HOLLE. F. VIVANCO, and M. GHISLAIN. 1995-96. Advance in the morphological characterization of Oca, Ulluco, Mashaau and Arracacha Collection. *http://www.cipotato.org/Market/PgmRprts/pr95-96/program2/ prog28.htm*.

BASSET, MARK. 1977. Breeding vegetable crops. The AVI Publishing Company Inc Westport Connecticut. Pp 285-515.

BORROMEO, T.H., P.L., SANCHES, E.J. QUINTANA and L.M. ENGLE 1994. Manual on rice genetic conservation and gene bank management. Nueva Ecija philrice. Pp. 22, 46-48.

CALDO, R. A and L.R. HIPOLITO. 1996. Diversity analysis of improvement rice (*Oryza sativa* L.*)* varieties and their progenitors using morphological characters and molecular markers. Philippine Rice R & D Highlights. PRRI, Maligaya, Munos, Nueva Ecija. P.7.

HOF, L. 1996. *Dimorphotheca pluvialis*: A new source of hydroxyl fatty acid. In: J. Janick (ed.), Progress in new crops. ASHS Press, Arlington, VA. *http://www.hort.purdue.edu/newcrop/proceedings1996/v3-372.html*. P. 372-377.

IBPGR. 1981. Report of the international board for plant genetic resources (IBPGR) working group on the genetic resources of sweet potato. Rome International Board for plant genetic resources. P. 30.

IPGR. 1994. In defense of diversity. Rome Italy. IPGRI Headquarters, via delle Settle Chiese. 142-00145. P. 24-28.

IGNACIO, J.C 2005. Morphological characterization in evaluation and diversity analysis of indigenous rice bean accession from Benguet. BS Thesis. BSU, La Trinidad Benguet.

KANG, M.S. 2002. Crop improvement. Challenges in the twenty first century. New York, London, Oxford food Product Press. An imprint of the Howard Press Inc.

PAGANAS, AMELINE M. 2005. Characterization and evaluation o commercially grown garden pea varieties in Benguet. BS Thesis. BSU, La Trinidad Benguet.

PECCETI, L., P, ANNICCHIARIACO and A.B. DAMANIA. 1992. Biodiversity in a germplasm collection of durum wheat. Euphytica 60 (9): 229-238.

POELMAN. J.M. 1997. Breeding fields crops. University of Missuri West Post, Connecticut. Avi Publishing Comp. Inc. Pp. 33-34.

PURSEGLOVE, J.W. 1972. Tropical crops: Dicotyledon. London; Longman group. Pp. 297.

REBUJIO, M.L. 2003. Morphological characterization diversity analysis and evaluation of sweetpotato genotypes. BS Thesis. BSU, La Trinidad Benguet.

SAWOR, I.P., P. CHADEKUN, E. ATMODO, E. RELAWATY, G. SITMORANG, D. PRAIN AND IL GINMOK. 1993. Interdisciplinary collection of (*Ipomea batatas* L). Germplasm and associated indigenous knowledge in Anggi, Irian Java Indonesia. International Potato Center (CIP). P. 5.

SIOPONGCO, L.B., N.C. ALTOVEROS, V.M. VERA CRUZ AND M.L.H. VILLAVICENCIO 1999. Morphological diversity in NPGRL'S local corn collection. The Phil. Journal of Crop Science. Published by the Crop Sci. Society of the Phil. Vol. 24 No. 2-3 Pp. 103.