Morphological Characterization of Field Pea (*Pisum sativum* L.Var. *arvense*) Genotypes based on DUS descriptors

Abstract

Field pea is one of the important rabi pulse crops that requires improvement to enhance productivity due to its growing demand. Morphological characterization provides a cost-effective and reliable approach to assess genetic diversity, which is vital for varietal identification, germplasm evaluation, and crop improvement. The experiment was conducted to assess morphological characterization of fifty-seven field pea genotypes, including two checks Pant P 554 and JM 6, evaluated at the Seed Breeding Farm, JNKVV, Jabalpur during *rabi* 2024–25 in a Randomized Complete Block Design with two replications. Observations were recorded on twenty morphological and visual traits at plant and seed levels as per DUS guidelines. Among the traits studied, most exhibited considerable variability. Traits such as stem anthocyanin colouration, leaf axil colour, flower standard petal colour, seed

testa mottling, seed parchment, and foliage waxy bloom showed dimorphic expression. Several traits including foliage colour, flower opening days, pod curvature, pod intensity of green colour, plant height, seed shape, seed surface, seed cotyledon colour, and 1000-seed weight displayed polymorphism, indicating wide morphological diversity among the genotypes. Stipule type showed monomorphic expression across all genotypes. The observed variation highlights the presence of substantial morphological diversity in the field pea germplasm, which can be effectively exploited for varietal identification, germplasm characterization, and future breeding programmes aimed at crop improvement.

Keywords: Field pea, Morphological Characterization, DUS descriptors

INTRODUCTION-

Field pea (*Pisum sativum* L. var. *arvense*) is one of the most important pulse crops cultivated in India, primarily during the winter season. It is an annual, herbaceous, self-pollinating legume extensively grown across temperate regions. Field pea has a diploid chromosome number of 2n = 14 and a genome size of approximately 4.5 Gb (Arumuganathan and Earle, 1991). The crop belongs to the family Fabaceae, the largest family of flowering plants, which comprises about 450 genera and 1200 species (Luitel *et al*.,2021). The genus *Pisum* includes two species: *Pisum fulvum* Sibth. and *Pisum sativum*. According to Vavilov (1949), the primary centres of origin of field pea are Ethiopia, the Mediterranean, and Central Asia.

Globally, field pea is cultivated across a wide range of agro-climatic regions, with major producers including Canada, Russia, China, and India. In India, it is primarily grown in Uttar Pradesh, Madhya Pradesh, and Bihar, with Uttar Pradesh being the leading producer. Due to its high nutritional value and wide adaptability, field pea is gaining importance as a food legume; however, its yield potential remains constrained by multiple production and breeding challenges.

Morphological traits reflect inherent genetic variation within germplasm, and are readily observable and serve as valuable indicators of the genetic composition of plant materials. Field pea plants generally attain a length of 120 to 150 cm

(approximately 4 to 5 feet). Flowers of field pea are hermaphroditic and cleistogamous, with self-pollination, it features the characteristic papilionaceous structure, comprising a standard petal, two wing petals and a keel. Floral coloration can range from white, pink, purple, blue or red. The seeds display variation in coat colour, including green yellow or creamy and are morphologically classified into three types: spherical, cylindrical and dimpled. Morphological characterization is universally acknowledged as the initial and fundamental step in the description, classification, and identification of genotypes. To facilitate accurate evaluation and utilization of genetic resources, plant breeders have established crop-specific descriptors based on DUS guidelines issued by PPV & FRA for all crops (Muhammad *et al*., 2009; Naghavi and Jahansouz, 2005; Able *et al*., 2007).

MATERIAL AND METHODS

The Experimental materials consist of fifty-seven field pea genotypes including two checks received from Department of Genetics and Plant Breeding, College of Agriculture, JNKVV, Jabalpur and IIPR, Kanpur. The experiment took place during the *Rabi* season of 2024-25 at the Seed breeding farm, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh in Randomized Complete Block Design with two replications. Each genotype had been sown in 5 meters row while plant to plant distance was 8-10 cm and row to row distance was 45 cm. From each replication, five plants were chosen to record observations on twenty morphological traits as per DUS guidelines (Table 1).

Table 1: Characterization based on DUS traits in fifty-seven genotypes of Field pea

S. No.	Characteristics	Stage of observation	Expression/ States	Note/ Score
1.	Stem: Anthocyanin colouration	Initiation of first flower	Absent	1
			Present	9
2.	Foliage: Colour	Initiation of first flower	Light green	3
			Green	5

			Dark green	7
3.	Foliage: Waxy bloom	Initiation of first flower	Absent	1
			Present	9
4.	Leaf: Leaflets	Initiation of first flower	Absent (Afila type)	1
			Present	9
5.	Leaf: Axil colour	Initiation of first flower	Green	1
			Purple	2
6.	Stipule: Rabbit eared stipule	Initiation of first flower	Absent	1
			Present	9
7.	Stipule: Type	Initiation of first flower	Normal	1
			Vestigial	3
8.	Flower: Opening(days)	50% of the plants with at least one open flower	Extra early (< 40)	1
			Early (40-50)	2
			Medium (51-70)	3
			Late (>70)	4
9.	Flower: Standard petal color	50% flowering	White	1
			Blue	2
			Pink	3
			Red	4
			Purple	5
10.	Pod: Number/Axil	Fully developed green pod stage	Single	1
			Double	2
			Multiple	3
11.	Pod: Curvature	Fully developed green pod stage	Absent	1
			Weak	3
			Medium	5
			Strong	7
12.	Pod: Shape of distal part	Fully developed green pod stage	Pointed	1
			Blunt	9
13.	Pod: Intensity of green colour	Fully developed green pod stage	Light green	3
			Green	5
			Dark green	7
14.	Plant: Height	Peak flowering	Short (<60 cm)	3

			Medium (60-80 cm)	5
			Long (>80 cm)	7
15.	Seed: Shape	Mature Seed	Spherical	1
			Cylindrical	2
			Dimpled	3
16.	Seed: Surface	Mature Seed	Smooth	1
			Wrinkled	2
17.	Seed: Cotyledon colour	Mature Seed	Creamy	3
			Green Yellow	5
18.	Seed: Weight of 1000 seed	Mature Seed	Small (<150 gm)	3
			Medium (150-200 g)	5
			Large (>200g)	7
19.	Seed: Testa mottling	Mature Seed	Absent	1
			Present	9
20.	Seed: Parchment	Fully developed green pod stage	Absent	1
			Present	9

RESULTS AND DISCUSSION

The expression and frequency distribution of different morphological and visual characteristics were examined at the plant and seed levels in fifty-seven field pea genotypes in accordance with the DUS criteria. Twenty different morphological traits served as the basis for this assessment. Below are the findings from these evaluations.

Plant level

Stem: Anthocyanin colouration

Anthocyanin pigmentation in the stem was recorded at the time of first flower initiation. Among the fifty-seven field pea genotypes evaluated, anthocyanin colouration in the stem was absent in fifty-four genotypes and present in only three genotypes.

Foliage: Colour

Based on foliage color, the field pea genotypes were classified into three groups: light green, green and dark green. This observation was made at the time of first flower initiation. It was found that fifteen genotypes had light green foliage, twenty-four had green, and eighteen exhibited dark green foliage.

Foliage: Waxy bloom

Field pea genotypes were classified based on the presence or absence of foliage waxy bloom. This trait was observed at the time of first flower initiation, and it was found that foliage waxy bloom was present in fifty-four genotypes and absent in three genotypes.

Leaf: Leaflets

Leaflets were observed at the time of first flower initiation and classified into two types: absent (Afila type) or present. In ten genotypes, leaflets were absent (Afila type), while in the remaining forty-seven genotypes, they were present.

Leaf: Axil color

Leaf axil color was recorded at the time of first flower initiation and classified into two types: green or purple. Fifty-three genotypes exhibited green axil color, while four genotypes showed purple axil color.

Stipule: Rabbit eared stipule

At the time of first flower initiation, rabbit-eared stipules were observed and classified into two types: absent or present. Rabbit-eared stipules were found to be absent in thirty-nine genotypes and present in eighteen genotypes.

Stipule: Type

At the time of first flower initiation, stipule type was observed and classified into two types: normal or vestigial. All fifty-seven genotypes were found to have normal stipules.

Flower: Opening (days)

Flower opening days were recorded when 50% of the plants had at least one open flower. Based on this, genotypes were classified into four categories: extra early (<40 days), early (40–50 days), medium (51–70 days), and late (>70

days). Among the field pea genotypes, two were classified as early (40–50 days), fifty as medium (51–70 days), and five as late (>70 days).

Flower: Standard petal colour

At the 50% flowering stage, the standard petal color of the flower was recorded and classified into five categories: white, blue, pink, red and purple. Among the field pea genotypes, only five exhibited purple-colored petals, while the remaining fifty-two genotypes had white-colored petals.

Pod: Number / axil

At the fully developed green pod stage, the number of pods per axil was recorded and classified into three categories: single, double and multiple. Among the field pea genotypes, seven exhibited single pods per axil, while the remaining fifty genotypes had double pods per axil.

Pod: Curvature

Pod curvature was observed at the fully developed green pod stage and classified into four categories: absent, weak, medium and strong. Curvature was absent in thirty-one genotypes, weak in twenty-three, and medium in three genotypes.

Pod: Shape of distal part

The shape of the distal part of the pod was observed at the fully developed green pod stage and classified as either pointed or blunt. Among the genotypes, thirty-nine had blunt pods, while eighteen had pointed pods.

Pod: Intensity of green color

Pod intensity of green color was observed at the fully developed green pod stage and classified into three categories: light green, green and dark green. Among the genotypes, twenty-eight were light green, twenty-four were green and five were dark green.

Plant: Height (cm)

Plant height was measured at the peak flowering stage and classified into three categories: short (<60 cm), medium (60–80 cm) and long (>80 cm). Among the

field pea genotypes, seventeen were short, nineteen were medium and twenty-one were long.

Seed Parchment

Seed parchment was observed at the fully developed green pod stage and classified as either absent or present. It was present in only five genotypes and absent in the remaining fifty-two genotypes.

Seed level

Seed: Shape

Seed shape was observed after harvest at the mature seed stage and classified into three groups: spherical, cylindrical, and dimpled. Among the genotypes, thirty-five were spherical, three were cylindrical and nineteen were dimpled.

Seed: Surface

Seed shape was observed after harvest at the mature seed stage and classified into two groups: smooth and wrinkled. Among the genotypes, forty-three were smooth, while the remaining fourteen were wrinkled.

Seed: Cotyledon colour

Seed cotyledon color was observed after harvest at the mature seed stage and classified into two groups: creamy and green-yellow. Among the genotypes, forty-seven had creamy cotyledons, while ten had green-yellow cotyledons.

Seed: Weight of 1000 seeds (gm)

The weight of 1000 seeds were measured after harvest at the mature seed stage and classified into three groups: small (<150 g), medium (150–200 g), and large (>200 g). Among the genotypes, five were small, thirty-five were medium, and seventeen were large.

Seed: Testa mottling

Seed testa mottling was observed after harvest at the mature seed stage and classified based on its presence or absence. Testa mottling was absent in fifty-two genotypes and present in only five genotypes.

Table 2: Frequency Distribution of Morphological Traits in Field pea Genotypes

S. No.	Characteristics	Stage of observation	Expression/ States	Note/ Score	Genotype frequency	Percentage contribution (%)	Name of genotypes
1.	Stem: Anthocyanin colouration	Initiation of first flower	Absent	1	54	94.73	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, HFP1904, PANT P574, PANT P568, HFP 20-506, HFP 20-67, RFP 2021-1, HUTP2202, Pant P562, Pant P559, IPFD 23-11, HFP1962, SKNFP 2008, HFP2029, JP885, AP2, G-10, HUP-2, Azad Pea-1, VRP-7, HFP-8909, JP-180, VL-3, PantP42, IM9102, VL42, PantP5, HFP529, KPMR144-1, PG3, SKNP-4-9, KPMR400, VL-1, VL-46, JM-6, HFP9907B, IFP4-26, HFP-9426, IM9101, IPFD99-13, HUDP15, DDR-44, IPF48, IPFD6-3, JAYANTI, HFP4, IPFD1-10
			Present	9	3	5.26	IPFD14-2, B22, INDIRA MATAR-1.
2.	Foliage: Colour	Initiation of first flower	Light green	3	15	26.13	Ambika, Adarsh, PANT P574, RFP 2021-1, HUTP2202, SKNFP 2008, AP2, HUP-2, PantP5, KPMR400, VL-46, IFP4-26, HUDP15, IPFD6-3, JAYANTI
			Green	5	24	42.10	Pant P-243, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, IPFD14-2, PANT P568, HFP

							20-506, HFP 20-67, Pant P562, JP885, HFP-8909, JP-180, PantP42, IM9102, VL42, KPMR144-1, JM-6, HFP9907B, HFP-9426, IM9101, DDR-44, IPF48, HFP529
			Dark green	7	18	31.57	HFP1904, Pant P559, IPFD 23-11, HFP1962, HFP2029, B22, G-10, Azad Pea-1, VRP-7, VL-3, HFP529, PG3, SKNP-4-9, VL-1, IPFD99-13, HFP4, IPFD1-10, INDIRA MATAR-1
3.	Foliage: Waxy bloom	Initiation of first flower	Absent	1	3	5.26	IPFD12-2, SKNFP 2008, IFP4-26
			Present	9	54	94.73	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD10-12, IPFD14-2, HFP1904, PANT P574, PANT P568, HFP 20-506, HFP 20-67, RFP 2021-1, HUTP2202, Pant P562, Pant P559, IPFD 23-11, HFP1962, HFP2029, B22, JP885, AP2, G-10, HUP-2, Azad Pea-1, VRP-7, HFP-8909, JP-180, VL-3, PantP42, IM9102, VL42, PantP5, HFP529, KPMR144-1, PG3, SKNP-4-9, KPMR400, VL-1, VL-46, JM-6, INDIRA MATAR-1, HFP9907B, HFP-9426, IM9101, IPFD99-13, HUDP15, DDR-44, IPF48, IPFD6-3, JAYANTI, HFP4, IPFD1-10, DMR-7
4.	Leaf: Leaflets	Initiation of first flower	Absent (Afila type)	1	10	17.54	Pant P-554, IPFD12-2, AP2, HUP-2, KPMR400, JAYANTI, HFP4, IPFD6-3, HUDP15, DDR-44

			Present	9	47	82.45	Ambika, Pant P-243, Adarsh, IPFD11-5, IPFD10-12, IPFD14-2, HFP1904, PANT P574, PANT P568, HFP 20-506, HFP 20-67, RFP 2021-1, HUTP2202, Pant P562, Pant P559, IPFD 23-11, HFP1962, SKNFP 2008, HFP2029, B22, JP885, G-10, Azad Pea-1, VRP-7, HFP-8909, JP-180, VL-3, PantP42, IM9102, VL42, PantP5, HFP529, PG3, SKNP-4-9, VL-1, VL-46, JM-6, INDIRA MATAR-1, HFP9907B, IFP4-26, HFP-9426, IM9101, IPFD99-13, IPF48, HFP4, IPFD1-10, DMR-7
5.	Leaf: Axil colour	Initiation of first flower	Green	1	53	92.98	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, PANT P574, PANT P568, HFP 20-506, HFP 20-67, RFP 2021-1, HUTP2202, Pant P562, Pant P559, IPFD 23-11, HFP1962, SKNFP 2008, HFP2029, JP885, AP2, G-10, HUP-2, Azad Pea-1, VRP-7, HFP-890 internationalization, JP-180, VL-3, PantP42, IM9102, VL42, PantP5, HFP529, KPMR144-1, PG3, SKNP-4-9, KPMR400, VL-1, VL-46, JM-6, HFP9907B, IFP4-26, HFP-9426, IM9101, IPFD99-13, HUDP15, DDR-44, IPF48, IPFD6-3, JAYANTI, HFP4, IPFD1-10
			Purple	2	4	7.01	IPFD14-2, HFP1904, B22, INDIRA MATAR-1

6.	Stipule: Rabbit eared stipule	Initiation of first flower	Absent	1	39	68.42	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD14-2, PANT P574, PANT P568, RFP 2021-1, HUTP2202, Pant P562, IPFD 23-11, HFP1962, SKNFP 2008, B22, JP885, AP2, G-10, HUP-2, VRP-7, PantP42, IM9102, VL42, PantP5, HFP529, PG3, KPMR400, VL-1, VL-46, JM-6, INDIRA MATAR-1, HFP9907B, IFP4-26, HFP-9426, IM9101, IPFD99-13, JAYANTI, HFP4
			Present	9	18	31.57	IPFD12-2, IPFD10-12, HFP1904, HFP 20-506, HFP 20-67, Pant P559, HFP2029, Azad Pea-1, HFP-8909, JP-180, SKNP-4-9, HUDP15, DDR-44, IPF48, IPFD6-3, IPFD1-10, KPMR144-1, DMR-7
7.	Stipule: Type	Initiation of first flower	Normal	1	57	100	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, IPFD14-2, HFP1904, PANT P574, PANT P568, HFP 20-506, HFP 20-67, RFP 2021-1, HUTP2202, Pant P562, Pant P559, IPFD 23-11, HFP1962, SKNFP 2008, HFP2029, B22, JP885, AP2, G-10, HUP-2, Azad Pea-1, VRP-7, HFP-8909, JP-180, VL-3, PantP42, IM9102, VL42, PantP5, HFP529, KPMR144-1, PG3, SKNP-4-9, KPMR400, VL-1, VL-46, JM-6, INDIRA MATAR-1, HFP9907B, IFP4-26, HFP-9426, IM9101, IPFD99-13, HUDP15, DDR-44, IPF48, IPFD6-3 , JAYANTI, HFP4, IPFD1-10, DMR-7
			Vestigial	3	0	0	NIL

8.	Flower: Opening(days)	50% Plants with at least one open flower	Extra early (< 40)	1	0	0	NIL
			Early (40-50)	2	2	3.50	HFP2029, JP-180
			Medium (51-70)	3	50	87.71	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, IPFD14-2, HFP1904, PANT P574, PANT P568, HFP 20-506, RFP 2021-1, HUTP2202, Pant P562, Pant P559, HFP1962, SKNFP 2008, B22, JP885, AP2, G-10, HUP-2, Azad Pea-1, VRP-7, HFP-8909, VL-3, PantP42, IM9102, VL42, HFP529, KPMR144-1, PG3, SKNP-4-9, KPMR400, VL-1, VL-46, JM-6, INDIRA MATAR-1, HFP9907B, IFP4-26, HFP-9426, IM9101, HUDP15, DDR-44, IPF48, JAYANTI, HFP4, IPFD1-10, DMR-7
			Late (>70)	4	5	8.77	HFP 20-67, IPFD 23-11, PantP5, IPFD99-13, IPFD6-3
9.	Flower: Standard petal color	50% flowering	White	1	52	91.22	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, PANT P574, PANT P568, HFP 20-506, HFP 20-67, RFP 2021-1, HUTP2202, Pant P562, Pant P559, IPFD 23-11, HFP1962, SKNFP 2008, HFP2029, JP885, AP2, G-10, HUP-2, Azad Pea-1, VRP-7, HFP-8909, VL-3, PantP42, IM9102, VL42, PantP5, HFP529, KPMR144-1, PG3, SKNP-4-9, KPMR400, VL-1, VL-46, JM-6, HFP9907B, IFP4-26, HFP-9426, IM9101, IPFD99-13, HUDP15, DDR-44,

							IPF48, IPFD6-3, JAYANTI, HFP4, IPFD1-10, DMR-7
			Blue	2	0	0	NIL
			Pink	3	0	0	NIL
			Red	4	0	0	NIL
			Purple	5	5	8.77	IPFD14-2, HFP1904, B22, JP-180, INDIRA MATAR-1
10.	Pod: Number/Axil	Fully developed green pod stage	Single	1	7	12.28	HFP 20-506, RFP 2021-1, HUTP2202, Pant P562, IPFD 23-11, JP-180, VL42
			Double	2	50	87.71	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, IPFD14-2, HFP1904, PANT P574, PANT P568, HFP 20-67, Pant P559, HFP1962, SKNFP 2008, HFP2029, B22, JP885, AP2, G-10, HUP-2, Azad Pea-1, VRP-7, HFP-8909, VL-3, PantP42, IM9102, PantP5, HFP529, KPMR144-1, PG3, SKNP-4-9, KPMR400, VL-1, VL-46, JM-6, HFP9907B, IFP4-26, HFP-9426, IM9101, IPFD99-13, HUDP15, DDR-44, IPF48, IPFD6-3, JAYANTI, HFP4, IPFD1-10, DMR-7, INDIRA MATAR-1
			Multiple	3	0	0	NIL

11.	Pod: Curvature	Fully developed green pod stage	Absent	1	31	54.31	Ambika, Pant P-554, IPFD12-2, IPFD10-12, IPFD14-2, HFP1904, PANT P568, HFP 20-506, HFP 20-67, RFP 2021-1, Pant P562, Pant P559, HFP1962, SKNFP 2008, HFP2029, G-10, PantP42, HFP529, KPMR144-1, PG3, SKNP-4-9, VL-46, JM-6, INDIRA MATAR-1, DMR-7, IM9101, IPF48, IPFD1-10, PantP5, VL-1, IPFD99-13
			Weak	3	23	40.35	Pant P-243, IPFD11-5, PANT P574, HUTP2202, IPFD 23-11, B22, HUP-2, Azad Pea-1, VRP-7, JP-180, VL-3, IM9102, VL42, KPMR400, HFP9907B, IFP4-26, HFP-9426, IPFD6-3, JAYANTI, HFP4, HUDP15, DDR-44, IPFD99-13
			Medium	5	3	5.26	Adarsh, JP885, AP2
			Strong	7	0	0	NIL
12.	Pod: shape of distal part	Fully developed green pod stage	Pointed	1	18	31.57	Adarsh, IPFD11-5, B22, HUP-2, Azad Pea-1, VRP-7, JP-180, VL-3, AP2, KPMR400, HFP9907B, IFP4-26, HFP-9426, JAYANTI, HFP4, HUDP15, DDR-44, IPF48
			Blunt	9	39	68.42	Ambika, Pant P-243, Pant P-554, IPFD12-2, IPFD10-12, IPFD14-2, HFP1904, PANT P574, PANT P568, HFP 20-506, HFP 20-67, RFP 2021-1, HUTP2202, Pant P562, Pant P559, IPFD 23-11, HFP1962, SKNFP 2008, HFP2029, JP885, G-10, PantP42, HFP529, KPMR144-1, PG3, SKNP-4-9, VL-46, JM-6, INDIRA MATAR-1, DMR-7, IM9101, IPFD6-

							3, IPFD1-10, PantP5, VL-1, IPFD99-13, VL42, HFP-8909, HFP 20-506
13.	Pod: Intensity of green colour	Fully developed green pod stage	Light green	3	28	49.12	Pant P-243, IPFD10-12, IPFD14-2, HFP1904, HFP 20-506, RFP 2021-1, Pant P562, Pant P559, HFP1962, SKNFP 2008, HFP2029, JP885, HUP-2, VL-3, VL42, KPMR400, JM-6, HFP9907B, IPFD6-3, JAYANTI, HFP4, DDR-44, IPFD1-10, HFP-8909, HFP 20-506, VL-46, KPMR144-1, IPFD 23-11
			Green	5	24	42.10	Ambika, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, PANT P574, PANT P568, HFP 20-67, HUTP2202, IPFD 23-11, B22, G-10, PantP42, HFP529, PG3, SKNP-4-9, INDIRA MATAR-1, DMR-7, IM9101, IPF48, HFP-9426, IFP4-26, VL-1, IPFD1-10
			Dark green	7	5	8.77	Azad Pea-1, IM9102, PantP5, HUDP15, IPFD99-13
14.	Plant: Height	Peak flowering	Short (<60 cm)	3	17	29.82	IPFD11-5, IPFD10-12, IPFD14-2, HFP1904, IPFD 23-11, AP2, G-10, HFP529, KPMR144-1, PG3, SKNP-4-9, DDR-44, IPFD6-3, JAYANTI, KPMR400, IPF48, IPFD1-10
			Medium (60-80 cm)	5	19	3.33	Pant P-554, IPFD12-2, HFP 20-506, HFP 20-67, Pant P559, HFP1962, HFP2029, Azad Pea-1, VRP-7, VL-3, PantP42, IM9101, DMR-7, JM-6, VL-1, HFP-9426, HFP4, HUDP15, IPFD99-13
			Long (>80 cm)	7	21	36.84	Ambika, Pant P-243, Adarsh, PANT P574, PANT P568, RFP 2021-1, HUTP2202, Pant

							P562, SKNFP 2008, B22, JP885, HUP-2, IM9102, VL42, HFP9907B, IFP4-26, INDIRA MATAR-1, JP-180, VL-46, HFP-8909, PantP5
15.	Seed: Shape	Mature Seed	Spherical	1	35	61.40	Adarsh, Pant P-554, IPFD11-5, PANT P574, PANT P568, RFP 2021-1, IPFD 23-11, HFP1962, B22, JP885, HUP-2, Azad Pea-1, VRP-7, JP-180, VL-3, PantP42, IM9102, VL42, PantP5, HFP529, KPMR400, VL-1, VL-46, DMR-7, HUDP15, JAYANTI, HFP4, IPFD1-10, HFP-8909, IFP4-26, HFP-9426, IM9101, IPFD99-13, DDR-44, AP2
			Cylindrical	2	3	5.26	Pant P562, INDIRA MATAR-1, IPF48
			Dimpled	3	19	33.33	Ambika, Pant P-243, IPFD12-2, IPFD10-12, IPFD14-2, HFP1904, HFP 20-506, HFP 20-67, HUTP2202, Pant P559, SKNFP 2008, HFP2029, G-10, KPMR144-1, PG3, SKNP-4-9, JM-6, HFP9907B, IPFD6-3
16.	Seed: Surface	Mature Seed	Smooth	1	43	75.43	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, PANT P574, PANT P568, HFP 20-506, RFP 2021-1, HUTP2202, IPFD 23-11, HFP1962, SKNFP 2008, HFP2029, JP885, HUP-2, G-10, PantP42, IM9102, VL42, PantP5, HFP529, KPMR144-1, PG3, SKNP-4-9, KPMR400, VL-1, VL-46, JM-6 , DMR-7, IM9101, IPFD6-3, IPFD1-10, HFP9907B,

							IFP4-26, JP-180, VL-3, IPF48, IPFD99-13, HFP-9426, HFP4, JAYANTI
			Wrinkled	2	14	24.56	IPFD14-2, HFP1904, HFP 20-67, Pant P562, Pant P559, B22, Azad Pea-1, VRP-7, AP2, INDIRA MATAR-1, HUDP15, DDR-44, HFP-8909
17.	Seed: Cotyledon colour	Mature Seed	Creamy	3	47	82.45	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, IPFD14-2, HFP1904, PANT P574, PANT P568, HFP 20-506, RFP 2021-1, HUTP2202, Pant P559, IPFD 23-11, HFP1962, SKNFP 2008, HFP2029, JP885, HUP-2, Azad Pea-1, PantP42, IM9102, VL42, PantP5, HFP529, KPMR144-1, PG3, KPMR400, VL-1, VL-46, JM-6, INDIRA MATAR-1, DMR-7, HFP9907B, IFP4-26, IM9101, IPFD6-3, IPFD1-10, HUDP15, DDR-44, JAYANTI, HFP4, AP2, VL-3, HFP-8909
			Green Yellow	5	10	17.54	IPFD10-12, HFP 20-67, Pant P562, B22, VRP-7, JP-180, SKNP-4-9, IPF48, HFP-9426, G-10
18.	Seed: Weight of 1000 seed	Mature Seed	Small (<150 gm)	3	5	8.77	Pant P-243, HFP1904, B22, JP-180, HFP-8909
			Medium (150-200 g)	5	35	61.40	Ambika, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, IPFD14-2, HFP 20-506, HFP 20-67, RFP 2021-1, HUTP2202, Pant P559, HFP1962, SKNFP 2008, JP885, HUP-2, Azad Pea-1, VRP-7, VL-3, PantP42, IM9102, VL42, PantP5, KPMR400, JM-6,

							IM9101, IPFD6-3, HFP4, HUDP15, DDR-44, AP2, G-10, IPFD1-10, HFP-9426, IPFD99-13, IPFD 23-11
			Large (>200g)	7	17	29.82	Adarsh, PANT P574, PANT P568, HFP2029, HFP529, PG3, SKNP-4-9, VL-1, VL-46, INDIRA MATAR-1, DMR-7, HFP9907B, IFP4-26, JAYANTI, KPMR144-1, IPF48, IPFD99-13
19.	Seed: Testa mottling	Mature Seed	Absent	1	52	91.22	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, PANT P574, PANT P568, HFP 20-506, HFP 20-67, RFP 2021-1, HUTP2202, Pant P562, Pant P559, IPFD 23-11, HFP1962, SKNFP 2008, HFP2029, JP885, HUP-2, Azad Pea-1, VRP-7, VL-3, PantP42, IM9102, VL42, PantP5, HFP529, KPMR144-1, PG3, SKNP-4-9, KPMR400, VL-1, VL-46, JM-6, DMR-7, HFP9907B, IFP4-26, HFP-9426, IM9101, IPFD6-3, JAYANTI, HFP4, IPFD1-10, G-10, IPFD99-13, DDR-44, AP2, HFP-8909, IPF48
			Present	9	5	8.77	IPFD14-2, HFP1904, B22, JP-180, INDIRA MATAR-1
20.	Seed: Parchment	Fully developed green pod stage	Absent	1	52	91.22	Ambika, Pant P-243, Adarsh, Pant P-554, IPFD11-5, IPFD12-2, IPFD10-12, IPFD14-2, HFP1904, PANT P574, PANT P568, HFP 20-506, HFP 20-67, RFP 2021-1, HUTP2202, Pant P562, Pant P559, IPFD 23-11, HFP1962, SKNFP 2008, HFP2029, B22, JP885, HUP-2, Azad Pea-1, PantP42,

							IM9102, VL42, PantP5, HFP529, KPMR144-1, PG3, KPMR400, VL-1, VL-46, JM-6, INDIRA MATAR-1, DMR-7, HFP9907B, IFP4-26, HFP-9426, IM9101, IPFD6-3, JAYANTI, HFP4, IPFD1-10, JP-180, HFP-8909, IPFD99-13, IPF48, HFP 20-506
			Present	9	5	8.77	AP2, VRP-7, VL-3, SKNP-4-9, DDR-44

Present

Absent

Stem: Anthocyanin Colourations

Light Green

Green

Dark Green

Foliage: Color

Present

Absent (Afila type)

Leaf: Leaflets

Purple **Green**

Leaf: Axil colour

Present **Absent**

Stipule: Rabbit eared stipule

Purple **White**

Flower: Standard petal colour

Absent **Weak** **Medium**

Pod: Curvature

Blunt **Pointed**

Pod: Shape of distal part

Smooth

Wrinkled

Seed: Surface

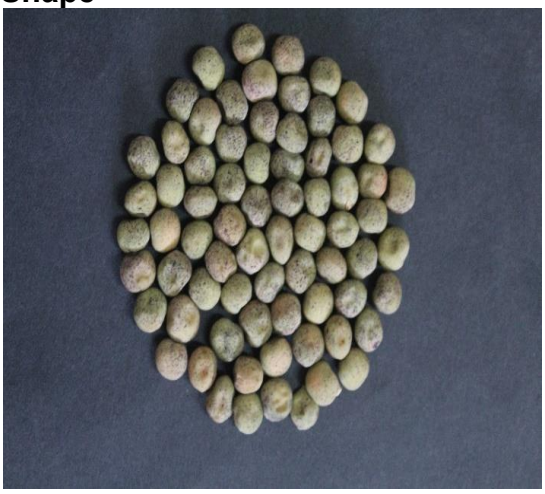
Spherical

Cylindrical

Dimpled

Seed: Shape

Absent



Present

Seed: Testa mottling

Plate 1: Morphological characterization

In the present investigation, all genotypes demonstrated ample variability for the majority of morphological traits *viz.*, stem anthocyanin colouration, foliage colour, foliage waxy bloom, leaf leaflets, leaf axil colour, stipule rabbit eared, flower opening days, flower standard petal colour, number of pod per axil , pod curvature, pod shape of distal part, pod intensity of green colour, plant height, seed shape, seed surface, seed cotyledon colour, weight of 1000 seed, seed testa mottling and seed parchment except stipule type.

Greater variation was observed for traits such as foliage colour, pod intensity of green colour, plant height, stem anthocyanin colouration, leaf axil colour and flower standard petal colour, whereas seed testa mottling exhibited the least variation. These observations were consistent with the findings reported by Yadav *et al.* (2019) and Anand *et al.* (2024). Likewise, the variability noted in leaf leaflets, stipule rabbit-eared trait, number of pods per axil, pod curvature, pod intensity of green colour, seed shape, seed surface and seed cotyledon colour were in accordance with the reports of Gour *et al.* (2018) and Anand *et al.* (2024). Furthermore, variation in pod shape of the distal part and seed cotyledon colour aligned with the findings of Umar *et al.* (2014) and Gour *et al.* (2018).

Leaf axil and flower standard petal colour were observed to be purple, which was in line with the findings of Gour *et al.* (2018), Ouafi *et al.* (2016) and Umar *et al.* (2014). A blunt distal pod shape was recorded in 39 genotypes, corroborating the observations of Kalapchieva *et al.* (2021). Observations on stipule type and seed parchment were consistent with the reports of Theint *et al.* (2020), Bishnoi *et al.* (2023) and Anand *et al.* (2024). Notable variation was recorded for flower opening days, seed surface and seed cotyledon colour, which aligned with the findings of Srilatha *et al.* (2022). Similarly, results for plant height and 1000-seed weight were in agreement with Theint *et al.* (2020).

Conclusion

Morphological characterization indicated that all genotypes exhibited high degree of variability across the majority of morphological traits *viz.*, foliage colour, leaf leaflets, leaf axil colour, stipule rabbit eared, flower opening days, flower standard petal colour, number of pods per axil, pod curvature, pod shape of distal part, pod intensity of green colour, plant height, seed shape, seed

surface, seed cotyledon colour, weight of 1000 seed. Seed testa mottling, seed parchment and stem anthocyanin colouration were observed in five, five and three genotypes respectively, foliage waxy bloom were absent in three genotypes, whereas no variation was observed for stipule type.

REFERENCES

1. Able JA, Langridge P and Milligan AS. 2007. Capturing diversity in the cereals many options but little promiscuity. Trends in Plant Science 12(2): 71–79.
2. Anand KJ, Singh SK, Nagre S, Patel T and Moitra P. 2024. Morphological characterization and diversity analysis in pea germplasm. Journal of Experimental Agriculture International 46(7): 189-99.
3. Arumuganathan K and Earle ED. 1991. Nuclear DNA content of some important plant species. Plant Molecular Biology Reporter 9(3): 208–218.
4. Bishnoi R, Marker S, Nayak A K, Basser P, Mayank and Sharma KK. 2023. Morphological characterization and morphological traits based genetic diversity analysis of farmer's pea (*Pisum sativum* L) varieties of Uttar Pradesh using DUS descriptors, as per PPV and FRA, 2001. Legume Research 46(7): 830-836.
5. Gour L, Dubey RK, Moitra PK, Singh SK, Shukla SS and Tiwari S. 2018.Genetic parameters exploration of pea genotypes using two environmental conditions. International Journal of Current Microbiology and Applied Sciences 7(9): 2067-2078.
6. Kalapchieva S, Dintcheva T, Tringovska I, Vasileva V and Kosev V. 2021. Phenotypic diversity of garden peas for ecological agricultural production. Agricultural Sciences/Agrarni Nauki 13(29): 27-32.
7. Luitel BP, Pun TB and Bhandari BB. 2021. Evaluation of growth and yield characters of garden pea genotypes at Dailekh, Mid-Western Nepal. Nepalese Horticulture 15(1): 24-33.
8. Muhammad S, Bacha S, Arshad M, Din R and Ghafoor A. 2009. Genetic diversity for determining yield potential and selection criteria in *Pisum*

sativum L genetic resources. Pakistan Journal of Botany 41(6): 2987-2993.

9. Naghavi MR and Jahansouz MR. 2005. Variation in the agronomic and morphological traits of Iranian chickpea accessions. Journal of Integrative Plant Biology 47(4): 375-379.
10. Ouafi L, Alane F, Rahal-Bouziane H and Abdelguerfi A. 2016. Agro-morphological diversity within field pea (*Pisum sativum* L.) genotypes. African Journal of Agricultural Research 11(40): 4039-4047.
11. Srilatha L, Dubey RK and Singh SK. 2022. Morphological characterization of field pea (*Pisum sativum* L.) Frontiers in Crop Improvement 10(2): 126-133.
12. Theint TT, Ravika, Yadav R and Suman. 2020. DUS Characterization of Field Pea Genotypes (*Pisum sativum* L.) Using Morphological Markers. International Journal of Current Microbiology and Applied Sciences 9(11): 1978- 1992.
13. Umar HMI, Rehman SU, Bilal M, Naqvi AH, Manzoor SA, Ghafoor A, Khalid M, Iqbal MT, Qayyum A, Ahmad F and Irshad MA. 2014. Evaluation of genetic diversity in pea (*Pisum sativu* L.) based on morpho-agronomic characteristics for yield and yield associated traits. Journal of Biodiversity and Environmental Sciences 4(5): 321-328.
14. Vavilov V. 1949. Phytogeographic basis of plant breeding. Botanika Chronika (Series II) 13(1): 13–54.
15. Yadav RDS, Purushottam MG, Bhati J and Yadav P. 2019. Diagnostic characteristics of field pea varieties. International Journal of Consevation Sciences 7(4): 1701-1702.