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Phenotypic evaluation of RIL population of Indian bean

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Abstract
The present investigation has been carried out to perform phenotypic evaluation of $F_{3:4}$ and $F_{4:5}$ RIL (Recombinant Inbred Line) population from the cross of homozygous parents GNIB-21 and GP-189 during 2018-2020. Nine traits were studied for segregating generations ($F_{3:4}$ and $F_{4:5}$). The mean performance of days to first raceme emergence was recorded at 41 days in $F_{3:4}$ and 56 days in $F_{4:5}$. Most of the plants in two generations were recorded for 10-30 pods per plants. The pod weight and seed per pod of most of the plants in both generations were 0.9 g and 3-4 seeds per pod. These phenotypic data would assist in future molecular research or for variety development.

Keywords: phenotypic, RIL, $F_{3:4}$ and $F_{4:5}$

Introduction
Indian bean (*Lablab purpureus* L. Sweet, Syn. *Dolichos lablab* L.) is a multi-purpose crop grown as vegetable (immature soft green pods and immature grains) and dried seeds are used as split pulse. It is predominantly a self-pollinated crop with chromosome number 2n=22 (Goldblatt, 1981) [3] belonging to the family Fabaceae and tribe phaseoleae. Being a legume, it fixes atmospheric nitrogen, hence famous as intercrop to enrich soil fertility. It is used as fodder, forage and cover crop (Magoon *et al.*, 1974) [6]. This crop is grown either in pure stands as a sole crop or intercropped with finger millet, groundnut, castor, corn, pearl millet and sorghum (Keerthi *et al.*, 2014) [5]. Indian bean is a good source of vegetable proteins because its seeds and pods contain 20-28 % protein (Devaraj, 2016; Habib *et al.*, 2017) [2, 4] and therefore could be a part of major protein source in the human diet for the vegetarian population. The crop has been grown year-round as a climber in kitchen gardens of nearly every hut in the tribal area of India for either pod, dal or sometimes as an ornamental. Variation in pod length and indeterminate growth habit are hallmarks of climbers grown in kitchen gardens. Immense genetic variability exists for the morphological and reproductive characters amongst the landraces grown all over the country (Chattopadhyay and Dutta, 2010; Parmar *et al.*, 2013) [1, 7].

Materials and Methods
The present investigation entitled as above was conducted during the year 2018-2020. F_3 population generated from crossing homozygous parents GNIB-21 and GP-189 was already available. Single Seed Descent (SSD) method was utilized to generate $F_{3:4}$ and $F_{4:5}$ RIL populations. Variability for traits such as days to first raceme emergence, days to first flower opening, growth habit, plant height (cm), racemes per plant, primary branches per plant, pods per plant, pod weight (g), seeds per pod and seed yield per plant (g) were observed for segregating generations ($F_{3:4}$ and $F_{4:5}$) under study. All the traits except days to first raceme emergence and days to first flower opening was recorded at physiological maturity.

Results and Discussion
Morphological evaluation of $F_{3:4}$ and $F_{4:5}$ RIL population was conducted in 2018 and 2019, respectively. The mean performance for nine traits in both years of RIL population ($F_{3:4}$ and $F_{4:5}$) *viz.*, 2018-19 and 2019-20 are tabulated in Table 1.
Mean for days to first raceme emergence was recorded at 41 days in $F_{3:4}$ and 56 days in $F_{4:5}$ with standard deviation 7.35 and 12.86, respectively. The range for days to first raceme emergence varied from 31 to 65 days in $F_{3:4}$ and 38 to 98 days in $F_{4:5}$ generation. RILs

manifested first flower opening at 37 days and 48 days in $F_{3:4}$ and $F_{4:5}$ generation with an average flower opening of 50 and 65 days in both populations, respectively. There was a huge variation accounted for plant height among RILs which ranged from 17-140 cm in $F_{3:4}$ and 14 to 135 cm in $F_{4:5}$, respectively. This variation is evident as the population showed variation for growth habit *i.e.*, determinate and indeterminate types. On average, the mean for racemes per plant, primary branches per plant, pods per plant, pod weight (g), seeds per pod and seed yield per plant (g) was 4.63, 3.51, 18.35, 0.90 g, 3.67 and 11.43 g for $F_{3:4}$ generation, respectively. Similarly, mean values observed for $F_{4:5}$ generation was 3.85, 2.29, 16.69, 0.96 g, 3.72 and 15.63 g, respectively for racemes per plant, primary branches per plant, pods per plant, pod weight (g), seeds per pod and seed yield per plant (g). These phenotypic data would assist in future molecular research or for variety development.

The frequency distribution for nine traits has also been presented in graphical view for $F_{3:4}$ and $F_{4:5}$ generation represented by year of trial *i.e.*, 2018 and 2019, respectively (Fig. 1 to 9). Most of the plants have 10-30 pods per plants. However, few plants with more than 40 or less than 10 pods were recorded. Around 20 plants with 15 g seed yield per plant in 2018-19 ($F_{3:4}$) and 18 plants with 20-25 g seed yield per plant were observed in 2019-20 ($F_{4:5}$). The pod weight and seed per pod of most of the plants in both generations were 0.9 g and 3-4 seeds per pod. Frequency distribution of primary branches per plant revealed that most plants in both generations had 2-4 primary branches per plant while very few had 5. Assessment of diversity using photosensitivity trait has been carried out by Sanaullah *et al.* (2012) [8] and Keerthi *et al.* (2014) [5].

Table 1: Mean performance of nine traits for $F_{3:4}$ and $F_{4:5}$ population in 2018-19 and 2019-20

Particulars	DRE		DF		PH		RPP		PBPP		PPP		PW		SPP		YPP	
	2018	2019	(2018)	(2019)	(2018)	(2019)	(2018)	(2019)	(2018)	(2019)	(2018)	(2019)	(2018)	(2019)	(2018)	(2019)	(2018)	(2019)
Mean	41.00	56.00	50.00	65.00	62.15	55.16	5.00	4.00	3.00	2.00	18.00	17.00	0.90	0.96	4.00	4.00	11.43	15.63
SD	7.35	12.86	8.58	14.66	24.09	27.10	2.59	1.66	0.94	0.88	10.79	9.61	0.26	0.21	0.66	0.70	7.13	9.21
Max	65.00	98.00	76.00	108.00	140.00	135.00	17.00	8.00	6.00	5.00	64.00	45.00	1.50	1.00	5.00	5.00	32.50	41.3
Min	31.00	38.00	37.00	48.00	17.00	14.00	1.00	1.00	2.00	1.00	3.00	3.00	0.30	0.50	2.00	2.00	1.10	2.00
SE	0.66	1.16	0.77	1.32	2.17	2.44	0.23	0.15	0.09	0.08	0.97	0.87	0.02	0.02	0.06	0.06	0.64	0.83

Where,

DRE-Days to raceme emergence (days), DF-Days to first flower opening (days), PH-Plant height (cm), RPP-Racemes per plant (number), PBPP-Primary branches per plant, PPP-Pods per plant (number), PW-Pod weight (g), SPP-Seeds per pod (number), YPP-Yield per plant (g), SD-Standard deviation, SE- Standard Error.

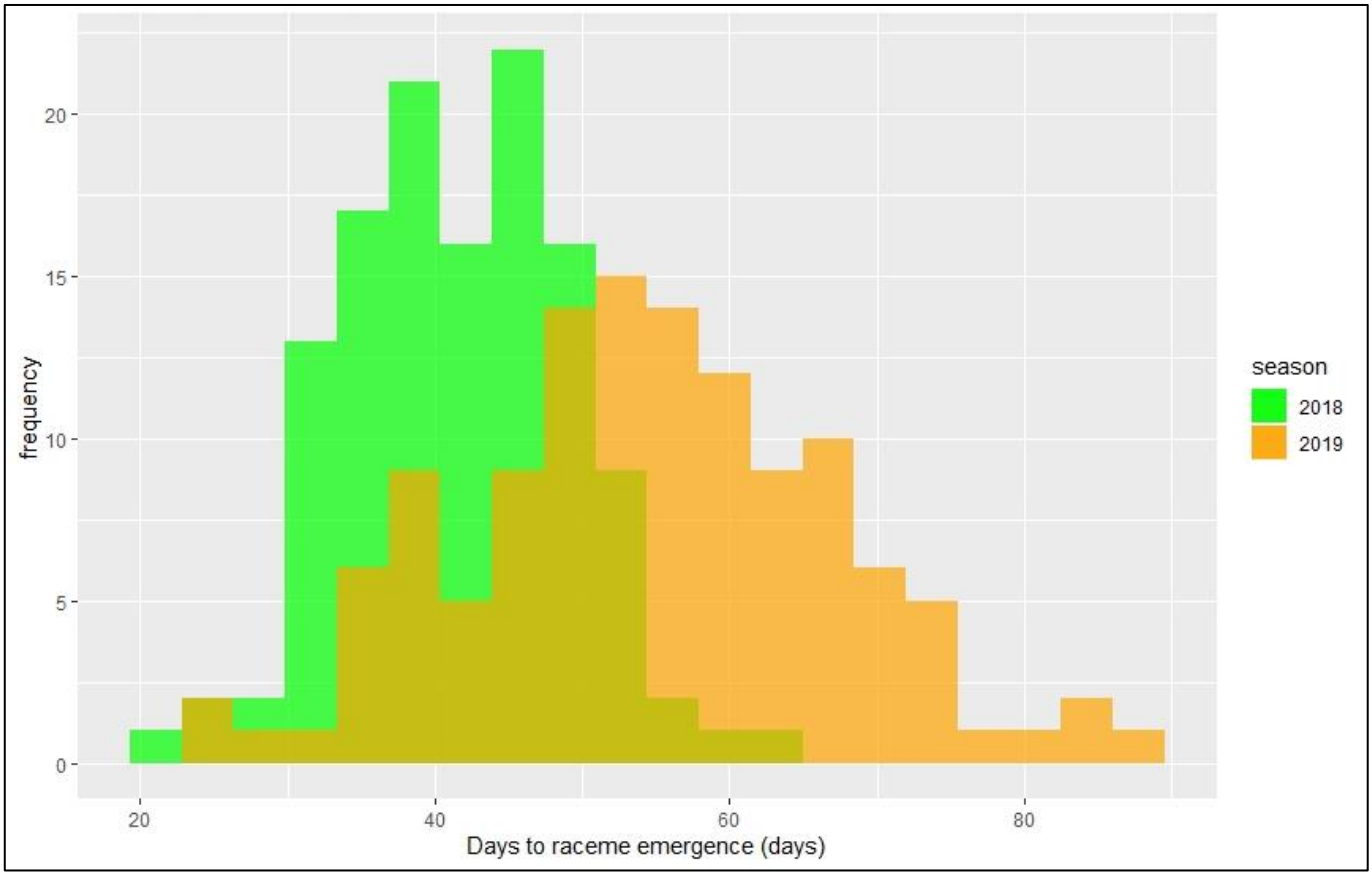

Fig 1: Frequency distribution of days to raceme emergence in $F_{3:4}$ (2018) and $F_{4:5}$ (2019) generations

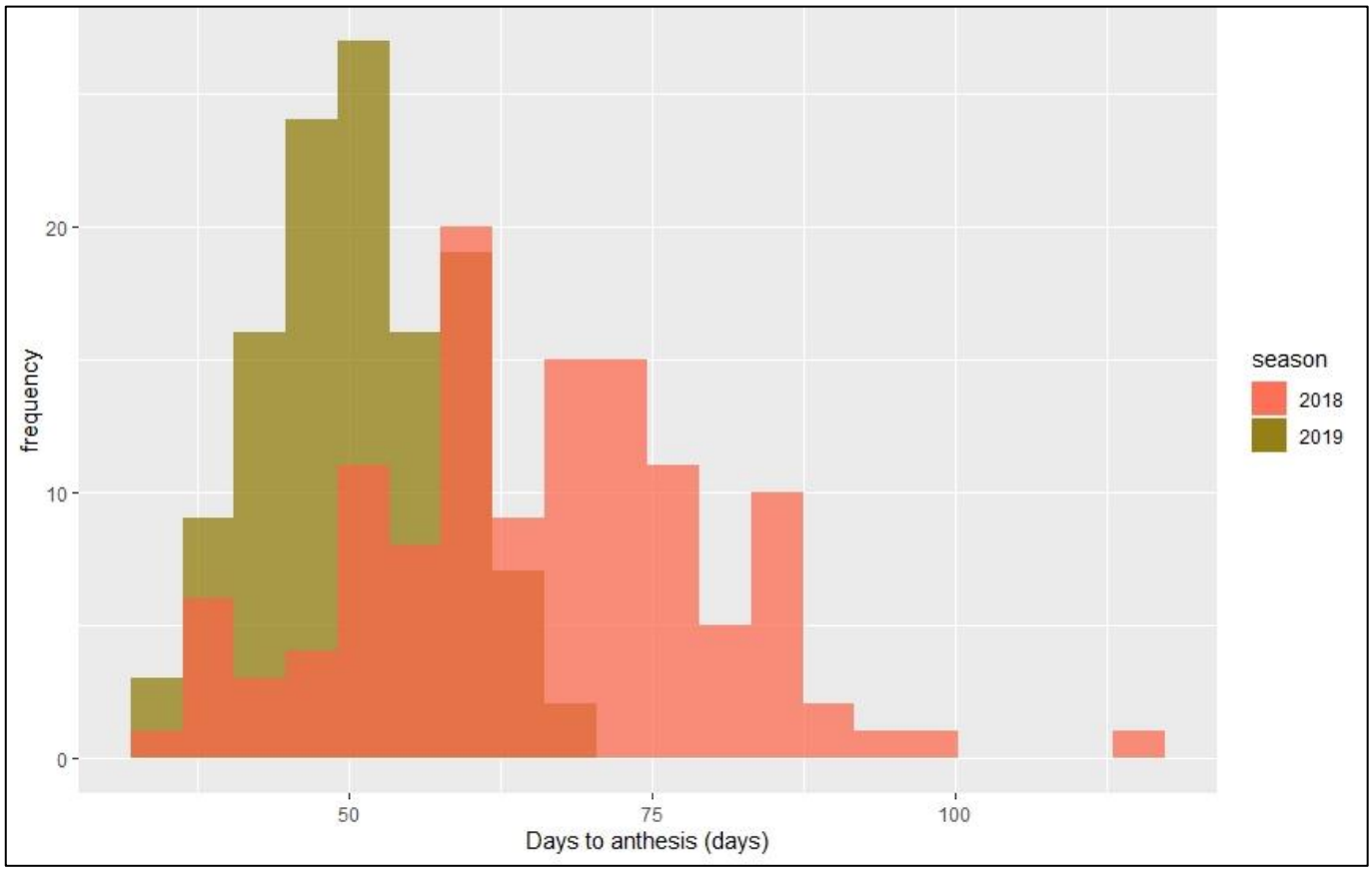

Fig 2: Frequency distribution of days to first flower opening in $F_{3:4}$ (2018) and $F_{4:5}$ (2019) generations

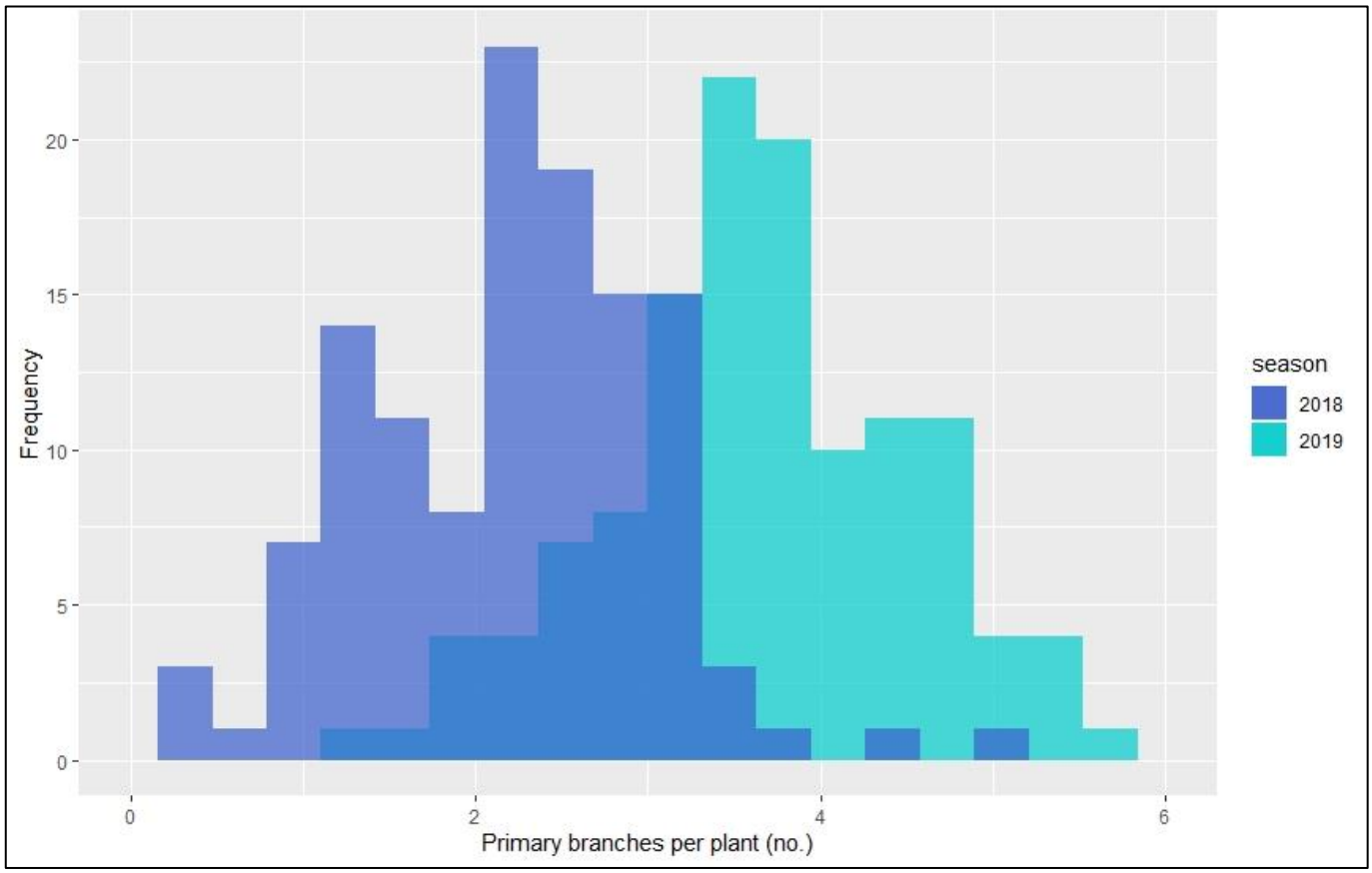

Fig 3: Frequency distribution of primary branches per plant in $F_{3:4}$ (2018) and $F_{4:5}$ (2019) generations

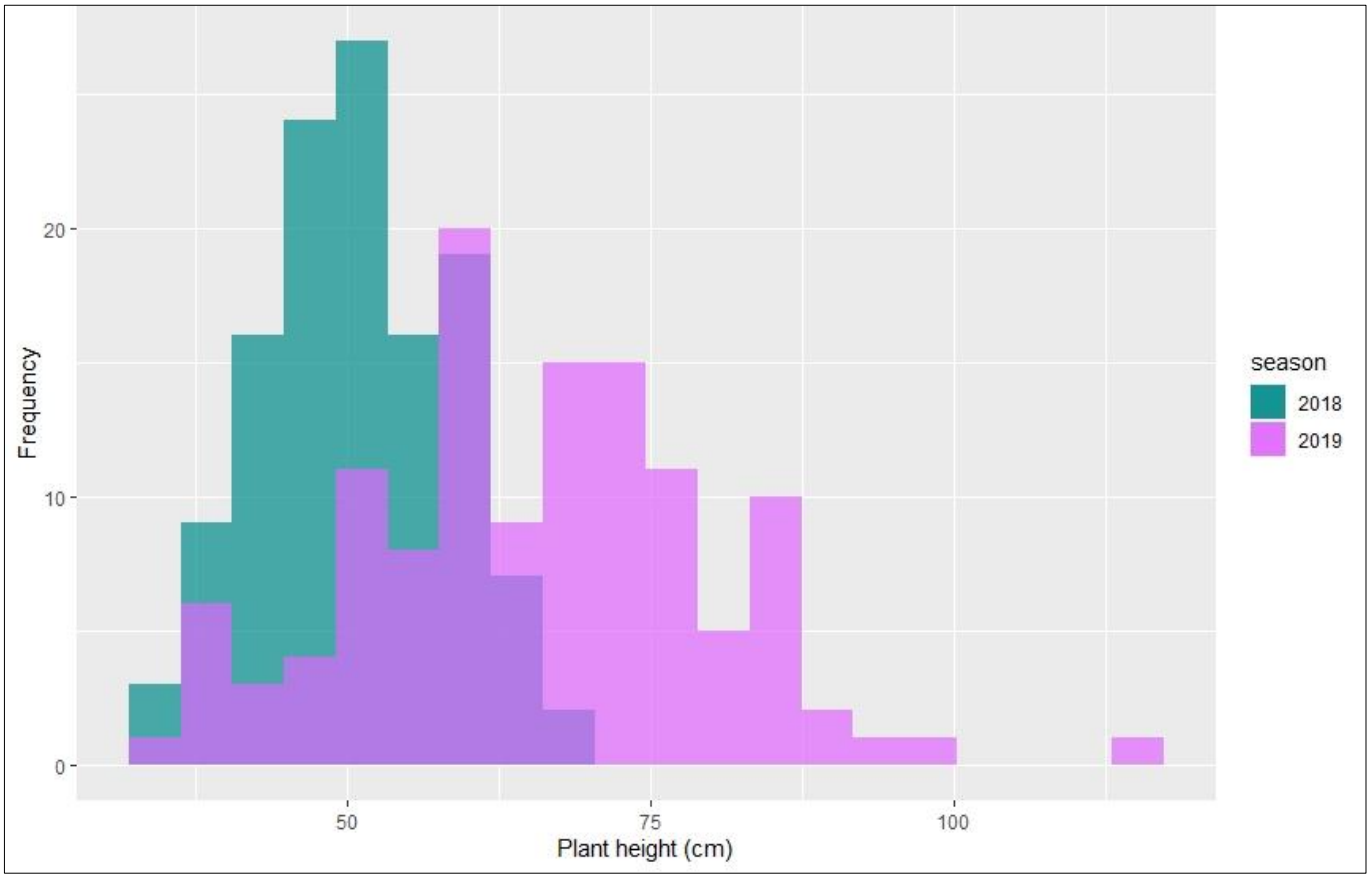

Fig 4: Frequency distribution of plant height in $F_{3:4}$ (2018) and $F_{4:5}$ (2019) generations

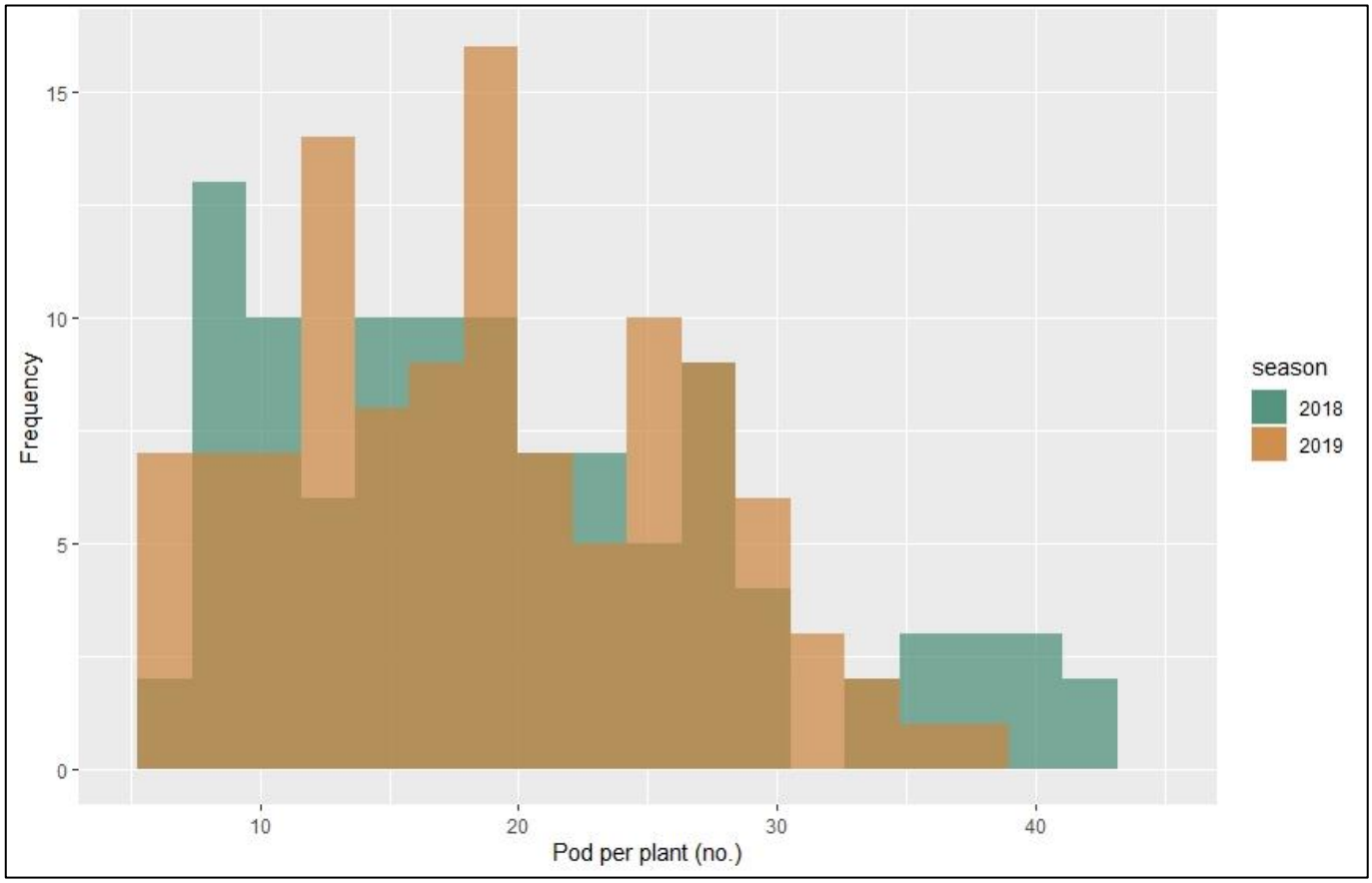

Fig 5: Frequency distribution of pods per plant in $F_{3:4}$ (2018) and $F_{4:5}$ (2019) generations

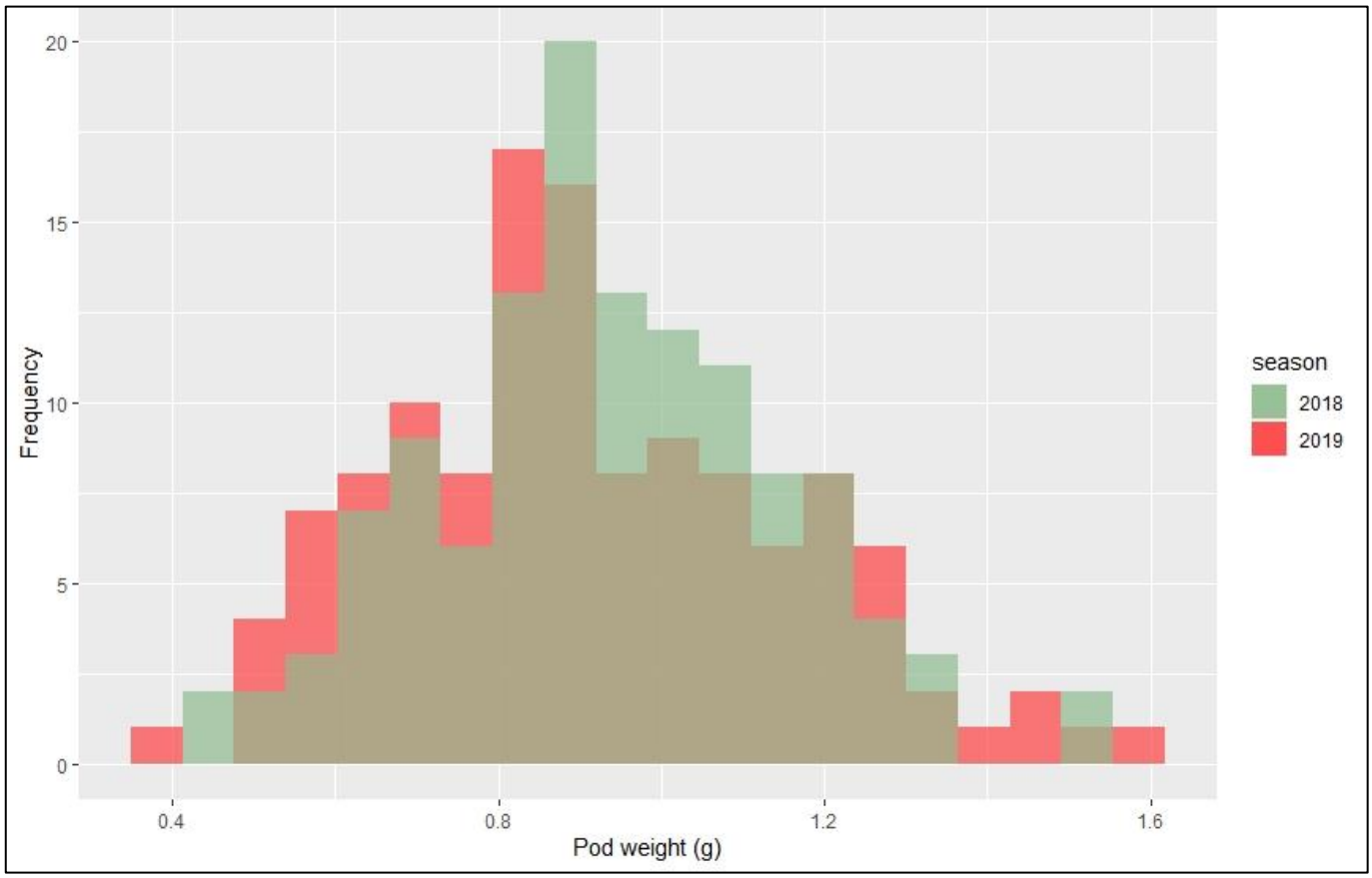

Fig 6: Frequency distribution of pod weight in $F_{3:4}$ (2018) and $F_{4:5}$ (2019) generations

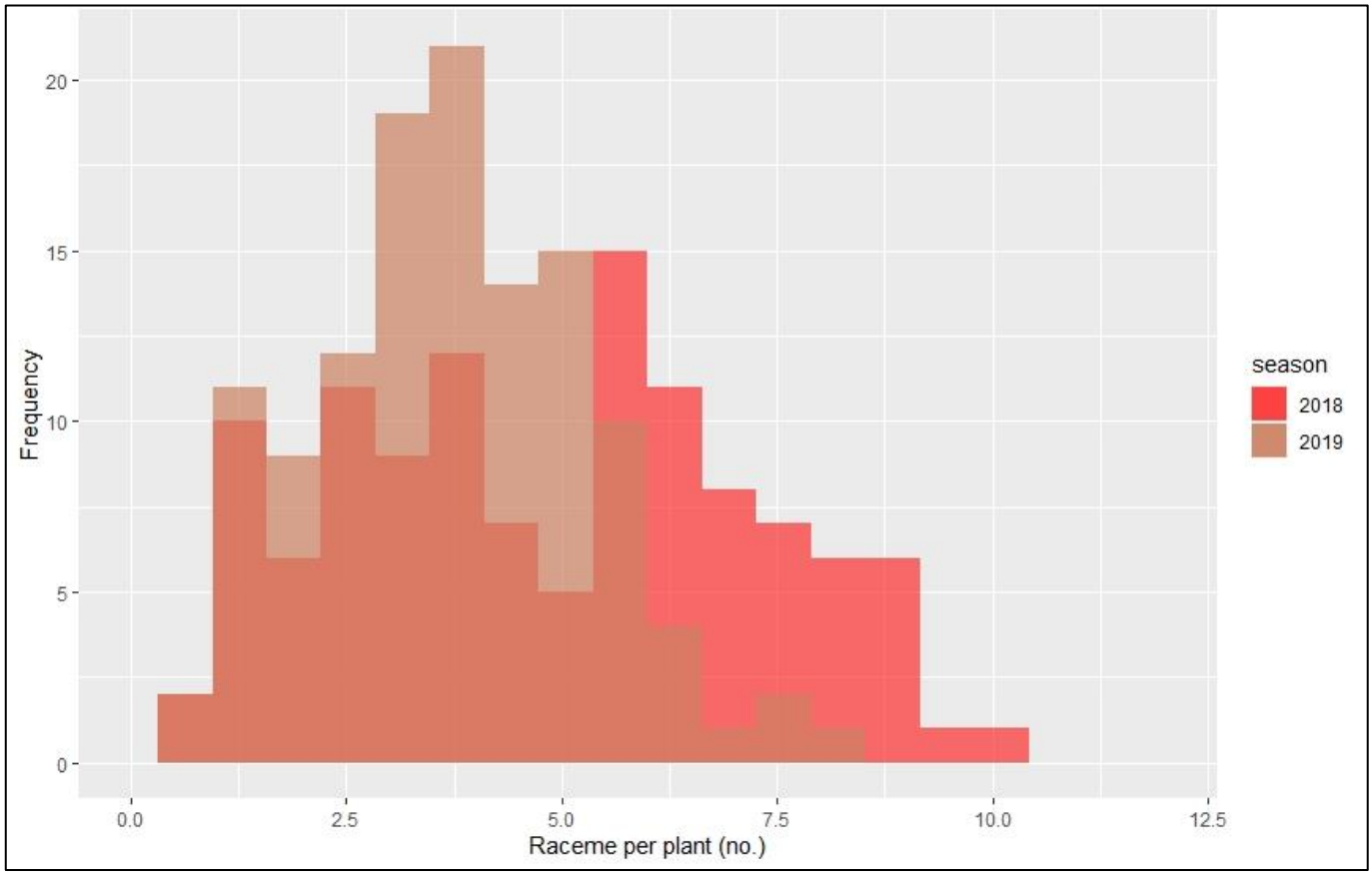

Fig 7: Frequency distribution of racemes per plant in $F_{3:4}$ (2018) and $F_{4:5}$ (2019) generations

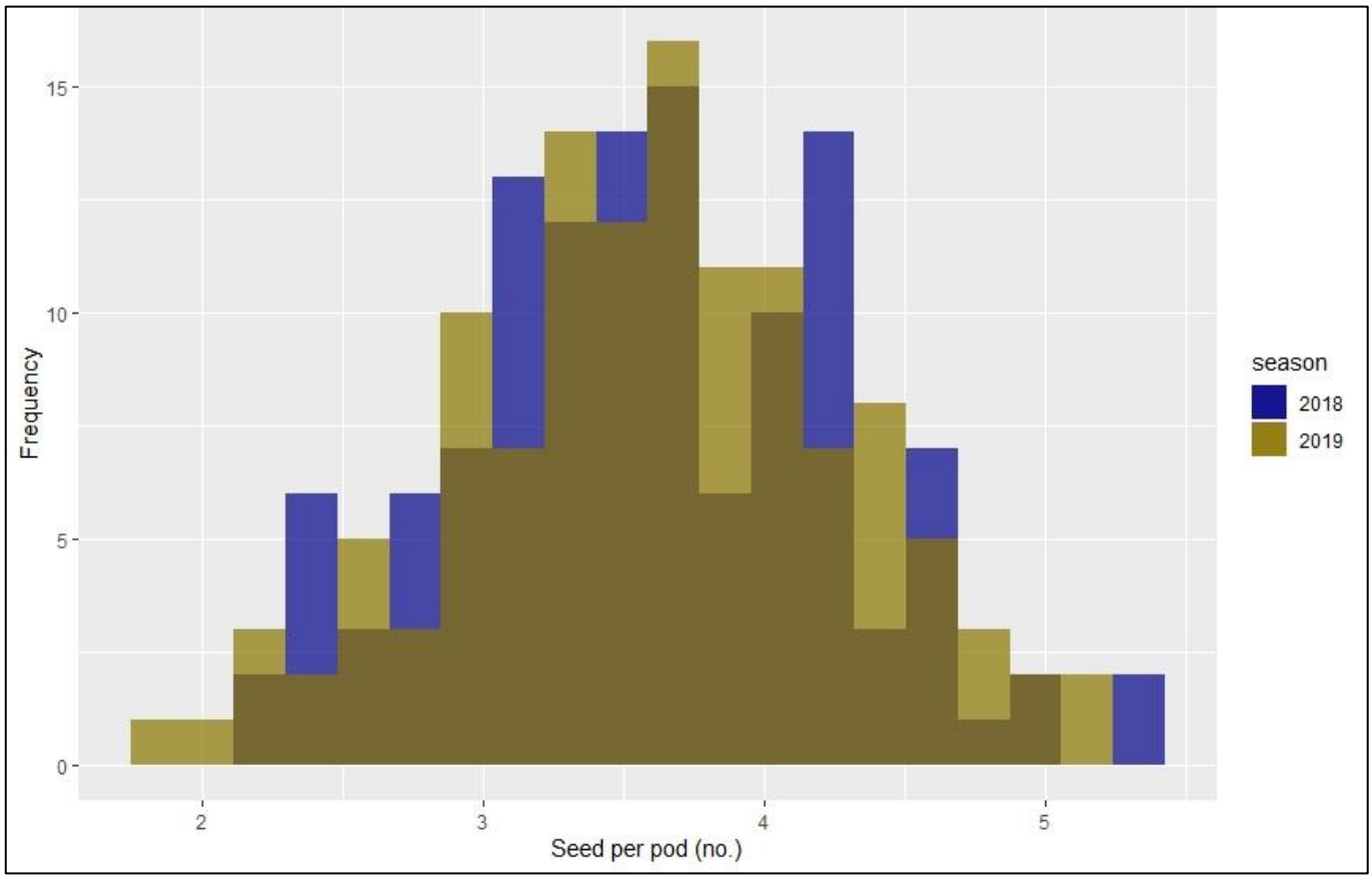

Fig 8: Frequency distribution of seeds per pod in $F_{3:4}$ (2018) and $F_{4:5}$ (2019) generations

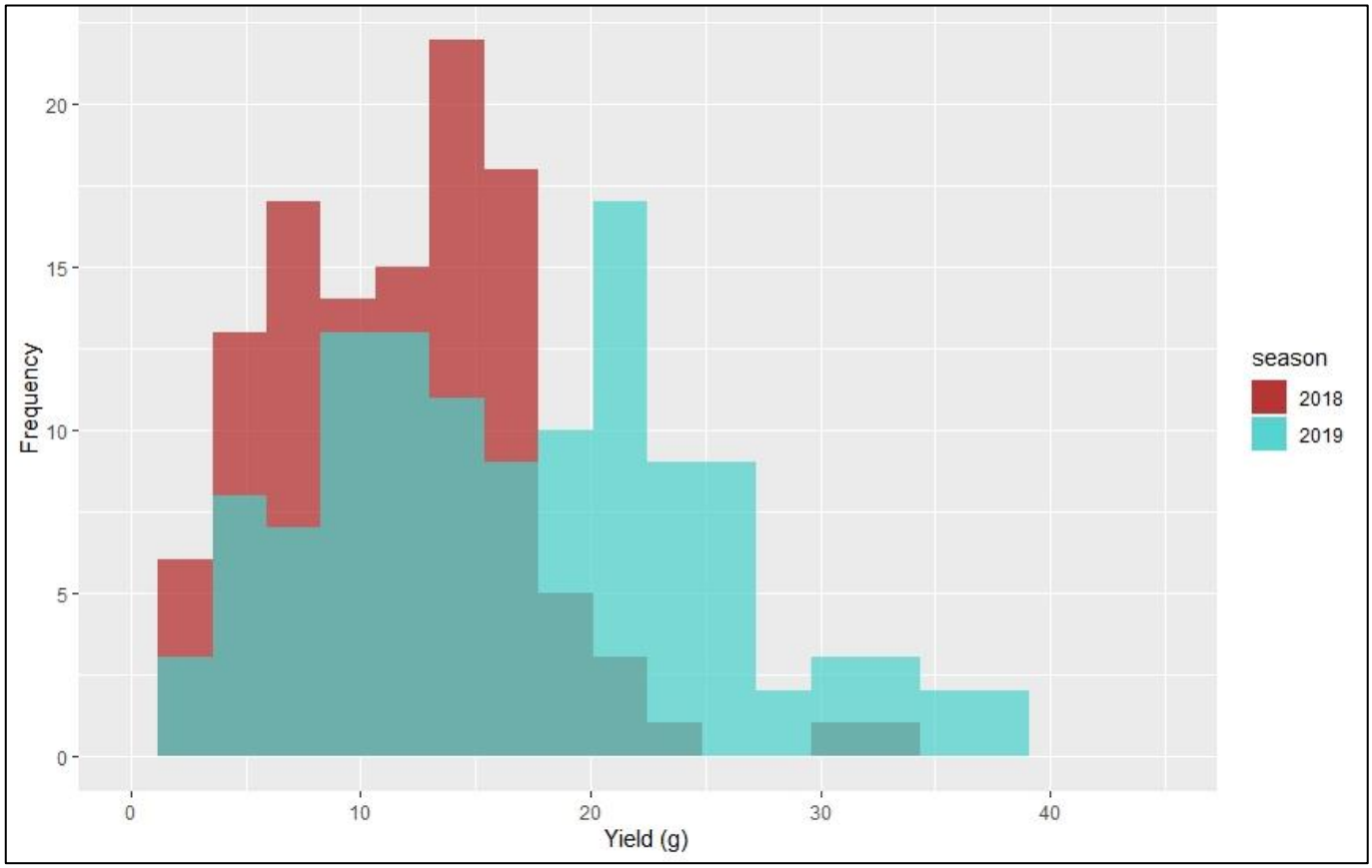

Fig 9: Frequency distribution of yield per plant in $F_{3:4}$ (2018) and $F_{4:5}$ (2019) generations

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