BEAN SEED QUALITY: ASSOCIATED GERMINABILITY AND FIELD PERFORMANCE

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ABSTRACT:

This work aimed to investigate the influence of different levels of bean seed quality on germinability (laboratory study), growth, yield and its components (green pod and dry seed yield) under field conditions. To achieve this study, the seed lot of bean (cv. Giza 3) was manually separated into three classes; light (33.79-38.02g 100^{-1} seeds; in 2005 season) and (34.39-37.13g 100^{-1}seeds; in 2006 season); ungraded (37.70-42.85g 100^{-1} seeds; in 2005 season) and (40.02-49.81g 100^{-1}seeds; in 2006 season) and heavy (47.20-57.60g 100^{-1} seeds; in 2005 season) and (48.75-57.13g 100^{-1} seeds; in 2006 season). Under field conditions, seeds of bean were sown during two summer successive seasons of 2005 and 2006 at the experimental station, Faculty of Agriculture, Fayoum University, Egypt. **The obtained data could be summarized as follows:**

High-weight class of bean seeds usually exhibited faster and more uniform rates of radicle emergence (as indicator of germination) than low-weight and ungraded ones. Seedling produced from heavier seeds had greater rates of QI, VI, length of radical hypocotyl and accumulation of fresh and dry weights than those from light seeds. The water uptake%, EC and the quantity of materials leached from the seed (Na, K, P_i, sugars, free amino acids and A^o_{260} and A^o_{280} absorbing materials) during imbibition were inversely related to seed weight. It is suggesting that interferences existed during seed development or deterioration had occurred in the low weight seed.

It can be noticed that seed quality of bean significantly affected field performance of bean plants and resulted in an increase of the studied plant growth traits (plant height, No. of leaves, No. of branches, leaf area leaf^{-1}, leaf area plant^{-1}, fresh and dry weights of leaves plant^{-1}, fresh and dry weights of branches plant^{-1}, and total fresh and dry weights of shoot plant^{-1}) with increasing the level of seed quality class. It can be seen that there was a close relation between seed quality of bean and green pods yield and its components. In this respect, No. of green pods plant^{-1}, weight of green pod, green pod yield plant^{-1} and feddan^{-1} were increased as seed quality class was increased. It was found that bean dry seed yield and its components; empty and seeded pods plant^{-1}, total No. of pods plant^{-1}, grades of dry seeded pods, No. of seeds plant^{-1}, seed yield plant^{-1} and feddan^{-1} and seed index (100-seed weight) was positively correlated with the class of sown seeds, the seeds which gave plants with high yield of dry seeds and its components were high in their quality and *vice versa*. It was shown that seed quality class markedly affected chemical constituents concentration of the different organs of bean plants produced from the different seed classes. In this respect, the high seed quality class significantly increased total sugars (total soluble carbohydrates in dry seeds), protein, N, P, K, Fe, Mn and Zn in leaves, green pods and dry seeds over that of light and ungraded seed classes.

Finally, in the light of the preceding results, it may be concluded that the results obtained suggest that the weight-seed separation of bean may enable for significantly improved germination and seedling growth. Also, high quality bean seeds to exhibit higher percent field performance and resulted in uniformity and establishment which reflected in high green pods and dry seed yield of bean either plant or feddan^{-1}. Thus, it concluded that it is likely that farmers by sowing seeds of high seed quality, will obtain yield increases of bean (green pods and dry seed).

Key words: Bean, Seed quality, Germination, Growth, Yield, Chemical composition

INTRODUCTION:

Seed quality is one of the most important factors affecting the performance and productivity of most agricultural crops (**Adul-Baki and Anderson, 1973; Brakke and Gardner, 1987 and Gadallah, 2000**). Seeds of many horticultural crops have been separated by size, weight, density and colour **(Smittle *et al*., 1976 and Smittle, 1982)**. Separation by seed weight offer a mean of improving germination, seedling growth for many crops. **(Smith and Camper, 1975 and Smittle, 1982)**. Most research has indicated that the larger the seed, the better germination and subsequent rate of growth **(Maranville and Clegg, 1977 and Qiu and Mosjidis, 1993)**. Research has emphasized the relationship of laboratory germination and seedling growth to seed quality **(Brakke and Gardner, 1987 and Gadallah, 2000),** but information relating seed quality to plant performance under field conditions is less available. Increased seed quality has been positively correlated with plant performance in the field **(Burris *et al*., 1973)**. Production of a crop depends upon obtaining a timely stand of uniform, healthy, vigorous plants; seed quality is important in obtaining such stand **(Maranville and Clegg, 1977)**. Although not all the responses are the same between crops, the balance of the evidence supports the use of the larger (heavier) seed within a given genotype **(Burris *et al*., 1973)**.

However, because there is less information relating seed quality to other aspects of crop performance, possible direct effects of seed quality on plant development and yield are still difficult to discern. Undoubtedly, if seed quality affects yield, its influence should be discernible through some effects on plant growth processes.

Therefore, one of the basic problems confronting the seed industry is being able to separate the high quality seed within a given seed lot. Sufficient information is not available to accurately define the relationship of seed quality to the behavior of bean under field conditions.

Accordingly, the present study sought to determine whether seed quality (of several seed lots differing in seed weight) could be sued to improve germinability, growth and yield of bean.

MATERIALS AND METHODS:

Experiments were conducted over 2 years of 2005 and 2006 in both laboratory and field, Fac. Agric., Fayoum Univ., Egypt. Seeds of bean (*Phaseolus vulgaris* L. cv. Giza 3) used in this study were produced by Ministry of Agriculture, Egypt. The original seed lot was manually separated into two weight classes identified: light and heavy. A portion of the original seed lot was retained to serve as ungraded class. The seed index (g 100^{-1} seeds) were determined for each seed class as a follows:

1- Light class (33.79-38.02g; in 2005 season) and (34.39-37.13g; in 2006 season).
2- Ungraded class (37.70-42.85g; in 2005 season) and (40.02- 49.81 g; in 2006 season).
3- Heavy class (47.20-57.60g; in 2005 season) and (48.75-57.13g; in 2006 season).

On 28 February of each season, light, heavy and ungraded seeds were used in this study to determine the relationship between seed quality and germinability and field performance of bean. The seeds of each class with visibly damaged and immature seeds were removed.

I. Laboratory study.

Seed quality measurements.

For determination of germination%, the suitable seeds (uniform and free from visible damage) were surface-disinfected for 30 seconds in 0.3 % Rizolex-T50 (0-2,6 –dichloro -4-methyl phenyl 0,0 -dimethyl phosphorothioate) solution (w/v), then washed thoroughly with distilled water. Four hundred seeds in eight replicates for each weight class were allowed to germinate using paper rolls method as described by the International Rules for Seed Testing (**ISTA, 1966**) in a darkened incubator at a constant temperature of 20^{o}C. The replicates from each class, were arranged in a complete randomized design. Germination% was monitored at 24h interval for 144h after sowing. Visible radicle protrusion was considered as a criterion for germination.

Quality index (QI) was carried out according the rules of **ISTA (1966).** This index provides information about the distribution of germination events over time.

Vigor index (VI) for each class was established by multiplying germination% by length of the hypocotyl plus radicle at the end of germination period (144h) as mentioned by **Abdul-Baki and Anderson (1973)**. This index was used as an indicator for providing information about the strength of seedling growth.

Seedling growth measurements.

Seedling growth measurements were recorded after 48, 72, 96, 120 and 144h from sowing. Ten seedlings replicate^{-1} were used for each class. At each time of the sampling, seedlings were separated into embryonic axes and cotyledons. **The following measurements were carried out:**

Length of seedling, ten embryonic axes were taken from each replicate for each class to determine their mean length after 48, 72, 96, 120 and 144h of germination. The length of both radicle and hypocotyl were also individually recorded for the 144 old seedlings.

Fresh and dry weights, fresh and dry weights of thirty embryonic axes of germinated seeds were recorded (immediately after sampling) from each replicate for each class. Fresh weights were determined immediately after sampling. These materials were dried at 70°C till constant weights were attained, then dry weight was obtained. The fresh and dry weights of both radicle and hypocotyl were also individually recorded for the seedlings after 144h. The dry material was ground in a mill for chemical analysis.

Water uptake and solute leakage measurements.

One hundred of uniform seeds and free from visible damage from each class were selected. The seeds were soaked in 100 ml of distilled water in a 250 ml beaker and allowed to leak for 8h at constant temperature of 20°C. Temperature was maintained during imbibitional period by immersing beakers with seeds into a thermo-regulated water bath. The experimental layout was complete randomized design with five replicates. Samples for water uptake and leakage analysis were taken at 1h interval up to 8h to quantity the rate of both water entry and solute efflux from seeds during imbibition. At each time of sampling (1h), the steep water was decanted from the seeds for analysis and the seeds were quickly blotted dry on filter paper and weighed to determine water uptake (as a percentage increase in initial fresh weight).

Also, electrical conductivity (EC) of the leakage was estimated ($dSm^{-1} 100^{-1}$ seeds) using a conductometer model LF-91 (Eijkelkamp Co., The Netherlands). Sodium and potassium (mg 100^{-1} seeds) were quantified with flame photometer (Gallenkamp Co., England). Inorganic phosphate, P_i (mg 100^{-1} seeds) was determined according to **Chen *et al*., (1956)**. Total nitrogen (mg 100^{-1}seeds) was measured by micro-kjeldahl procedure **(AOAC, 1990)**. Free amino acids (mg 100^{-1} seeds) were quantified with ninhydrin method **(Rosein, 1957)**, using glycine as a standard. Total sugars (mg 100^{-1} seeds) were estimated according to phenol-sulphoric technique **(Dubois *et al*., 1956)**, using glucose as a standard. Measurements of leakage absorbing UV light at A^o260 and A^o280 due to protein and nucleic acids were estimated **(Duke *et al*., 1983)**.

II. Field study.

Before sowing of bean seeds, soil samples (0-30 cm/depth) were taken each year and analyzed according to published procedure **(Black, 1965)**. Soil analysis results in 2005 and 2006 are shown in Table (1).

Table (1): Physical and chemical properties of the selected soil before sowing in both seasons

Property	2005	2006
Physical:		
Clay%	42.6	40.4
Silt%	31.4	32.3
Sand%	26.0	27.3
Texture	Clay	Clay
Chemical:		
pH	7.30	7.34
ECe (dSm^{-1})	4.40	5.02
Total N%	0.10	0.07
Organic matter%	2.11	2.12
$CaCO_3$%	7.17	7.30
Soluble cations (meq $100g^{-1}$):		
Ca^{++}	0.75	0.68
Mg^{++}	0.67	0.75
Na^{+}	1.98	2.47
K^{+}	0.03	0.02
Soluble anions (meq $100g^{-1}$):		
HCO_3^{-}	0.29	0.28
Cl^{-}	1.55	1.83
SO_4^{--}	1.59	2.22
Available microelements (ppm):		
Fe	35.27	38.16
Zn	2.06	2.16
Mn	20.95	21.34
Cu	0.09	0.11

Plots were arranged in a randomized complete block design, replicated 3 times. Each plot consisted of 6 rows; 5 m long and 70 cm a part, within row spacing was 10 cm. Seeds of each class were hand sown in the field on the 28^{th} February in both 2005 and 2006 seasons. Plots were seeded in excess and after emergence; plants were thinned to the desired stand (300 plants $plot^{-1}$). All other cultural practices for growing bean were applied according to those recommended by the Ministry of Agriculture, Egypt.

Plant Sampling.

At flowering, 10 plants randomly chosen from each replicate for each class were carefully cut off at the ground level and the following parameters were recorded: plant height (cm), No. of leaves and branches $plant^{-1}$, fresh and dry weights of leaves and branches $plant^{-1}$ (g), total fresh and dry weights of shoot $plant^{-1}$ (without root), leaf area $leaf^{-1}$ (cm^2, using a digital leaf meter, Planimeter Lincolin, L1-3000 portable area Meter produced by L1-COR, Nebraska, USA) and leaf area $plant^{-1}$ (cm^2). At 60 days from sowing (maturity of green pods); yield and its components were recorded from the whole two middle rows (throughout 21 days at 7 days interval) and the following measurements were recorded: No. of green pods $plant^{-1}$, fresh and dry weights pod^{-1}, fresh and dry weights of pods $plant^{-1}$ (g) and green pods yield $feddan^{-1}$ (ton). In each plot, plants of the 5 and 6 rows were left growing till pods approached the dry stage (90 days from sowing). The dry pods of twenty plants of each row picked and divided into two batches, empty and seeded pods. Total number and weight of empty and seeded pods were recorded. Seeded pods were sorted into 5 various grades: grade (**A**)-pods containing 1 seed pod^{-1}, grade (**B**)-pods containing 2 seeds pod^{-1}, grade (**C**)-pods containing 3 seeds pod^{-1}, grade (**D**)-pods containing 4 seeds pod^{-1} and grade (**E**)-pods containing 5 seeds pod^{-1}. Number and weight of pods in each of the previous grades was counted and the seeds were handy obtained. Dry seeds weight plant^{-1} (g), seed yield feddan^{-1} (kg), seed index (100-seed weight, g) were determined from air-dried seeds which contained approximately 10% moisture.

Chemical analysis.

In both seasons; at flowering stage, samples of fresh and dried leaves as well as fresh and dried green pods of 60 days old plants and powdered dry seeds (at harvesting time) were used for determining the following chemical constituents (the samples were dried in electric oven at 70^{o}C till constant weight, then well ground for chemical analysis). In fresh leaves, leaf pigments; chlorophyll a, b and total and carotenoids (mg g^{-1} fresh weight of leaf) were estimated. They extracted by acetone 80% then determined using colorimetric method as described by **Arnon (1949)**. In dried leaves, the following parameters were determined: N% was colorimetrically determined by using orange G dye according to the method of **Hafez and Mikkelsen (1981)**. For P, K, Fe, Mn and Zn determination, the wet digestion of 0.1 g of ground dry material of leaves of each class was done with sulphoric and perchloric acids as described by **Piper (1947)**. P(mg 100^{-1} g dry matter) was colorimetrically estimated by using chlorostannous molybdophosphoric blue colour method in sulphoric acid system as described by **Jackson (1967)**. K (mg 100^{-1} g dry matter) was determined using a Perkin-Elmer, Flame-photometer **(Page *et al*., 1982)**. Fe, Mn and Zn concentrations (mg 100^{-1}g dry matter) were determined using a Perkin-Elmer, Model 3300, Atomic Absorption spectrophotometer according to the method described by **Champman and Pratt (1961)**. In green pods and dried seeds, N, P, K, Fe, Mn and Zn concentrations were determined using the same analytical methods as mentioned before. In addition, total sugars (in ethanolic extract, 80% of leaves and green pods) and total soluble carbohydrates% (in digestive dry matter with sulphoric acid; 0.1 N of dry seeds) were colorimetrically determined using phenol-sulphoric acid reagent method as outlined by **Dubois *et al*. (1956)** as well as protein% were estimated by multiplying seed or green pod N% by a factor of 6.25 for conversion of N% to protein% **(Kelley and Bliss, 1975)**.

Statistical analysis.

According to the experimental design used (a randomized complete design for laboratory study and a randomized complete blocks design for field study), appropriate analysis of variance on the obtained results were achieved **(Snedecor and Cochran, 1980)**. The least significant difference test (LSD) at 0.05 level was used to verity the difference between treatments mean.

RESULTS AND DISCUSSION:

I. Laboratory study.

Seed index. Seed index was significantly varied among the seed classes of bean (Table 2). The heavy class seeds was the best whereas the light class seeds was the worst. Thus, a manual separation of bean seeds has strong effect on seed index.

Germination%. Data in Table (2) show that germination% increased gradually as germination proceeded for different seed classes of bean. Germination% significantly differed among seed classes. It is also clear that during germination period, the highest percentage of germination was recorded by the heavy seeds class as compared to that of light and ungraded classes, which showed an increases in the germination% by 76.19%, 77.78%, 47.41%, 12.82% and 17.72% above that of light seeds class and by 27.59%, 15.66%, 9.62%, 8.64% and 9.41% above that of ungraded seeds class after 48, 72, 96, 120 and 144h of germination in the first season, respectively. In the second season, the increases were: 117.65%, 168.83%, 35.51%, 25.36% and 22.93% above that of light seeds class and by 21.31%, 27.78%, 5.06%, 5.41% and 13.20% above that of ungraded seeds class after 48, 72, 96, 120 and 144h of germination, respectively. These data strongly suggest that separation of bean seed by weight is desirable for maximizing germination. This result may be due to that nutrient reserves are greater for the heaviest seed and would support germination to better extent. In this respect, heavy seed showed a high germination% and early vigorous seedling growth as compared with light seeds **(Gray and Steckel, 1986; Naylor, 1993 and Bredemeier *et al*., 2001)**. The obtained results are in agreement with those of **King and Lamkin (1979); Qiu and Mosjidis (1993) and Gadallah (2000)**.

Quality and Vigor indices.

Quality index (QI) and vigor index (VI) were higher for heavy seeds class than the others (Table 2). At the end of germination period 144h, the QI of heavy seeds increased over the light and ungraded ones by 38.13% and 11.20% respectively, in the first season while in the second one, the increases were: 52.43% and 12.74%, respectively. Data in Table (2) also indicate that, heavy seeds recorded significant increases in VI as compared to that of light and ungraded ones. The increases reached: 216.46% and 93.16% in the first season, respectively, while in the second one, the increases were: 197.83% and 78.60%, respectively. This means that the heavy seeds of bean are considered the best quality seed lot, while the light seeds are considered the worst one. Thus, the reduction of vigor in light seeds (as expressed by quality and vigor indices) may be associated with decline in respiration and synthesis of proteins and carbohydrates **(Abdul-Baki and Anderson, 1973)**.

Radicle length, hypocotyl length and fresh and dry weights of embryonic axes.

The effects of different seed weight classes on a radicle length, hypocotyl length as well as fresh and dry weights of embryonic axes of bean seedlings were significant (Table 3). At any seed class, increasing the germination period from 72 to 144h, were associated with progressive increases in the length of radicle. It is obvious that, decreasing the seed weight class was accompanied with reductions in length of radicle and hypocotyl as well (after 144h of germination) fresh and dry weight. These unsatisfactory results of light seed class may be related to loss of vigor and perhaps undesirable metabolic changes in their axes, which was considered the site of vigor, had occurred **(Abdul-Baki and Anderson, 1973)**. A similar result had been found by **Sayed *et al*. (1990) and Gadallah (2000)**.

Table (2): Seed index, germination%, quality index (QI) and vigor index (VI) of bean seeds as affected by seed quality class in both seasons

Seed class	Seed index	Germination time (h)						
		Germination %					QI	VI
		48	72	96	120	144	144	
1st season								
Light	33.79- 38.02	10.50	27.00	58.00	78.00	79.00	57.52	274.75
Ungraded	37.70 - 42.85	14.50	41.50	78.00	81.00	85.00	71.45	450.12
Heavy	47.20 - 57.60	18.50	48.00	85.50	88.00	93.00	79.45	869.47
LSD$_{(0.05)}$		**3.11**	**5.02**	**5.71**	**2.92**	**4.07**	**6.44**	**68.14**
2nd season								
Light	34.39 - 37.13	8.50	19.25	61.25	70.00	78.50	53.06	277.29
Ungraded	40.02 - 49.81	15.25	40.50	79.00	83.25	85.25	71.74	462.40
Heavy	48.75 - 57.13	18.50	51.75	83.00	87.75	96.50	80.88	825.84
LSD$_{(0.05)}$		**2.72**	**4.32**	**2.81**	**3.09**	**5.31**	**7.19**	**58.42**

Table (3): Radical length (cm), hypocotyl length (cm) and embryonic axes fresh and dry weights (g 10^{-1} axes) of bean seedling as affected by seed quality class in both seasons

Seed class	Germination time (h)						
	Radical length (cm)				Hypocotyl length (cm)	Embryonic axes	
						Fresh weight (g)	Dry weight (g)
	72	96	120	144	144	144	
1st season							
Light	1.10	3.40	5.42	8.88	3.50	7.92	0.75
Ungraded	1.30	4.88	6.28	10.28	5.28	9.51	2.44
Heavy	1.88	5.75	8.68	14.57	9.01	10.39	3.15
LSD$_{(0.05)}$	**0.11**	**0.60**	**0.61**	**1.08**	**1.12**	**0.80**	**0.62**
2nd season							
Light	1.31	2.80	4.83	7.68	3.51	9.90	1.00
Ungraded	1.45	4.94	6.68	10.56	5.44	11.88	3.05
Heavy	1.94	6.08	8.18	13.29	8.88	12.99	3.89
LSD$_{(0.05)}$	**0.39**	**0.69**	**1.19**	**1.83**	**0.94**	**0.59**	**0.47**

Water uptake.

Table (4) clearly show that, an increase in water uptake was observed during all the time of imbibition (up 8h) for the seeds of the different seed weight classes, although differential rates of water uptake had developed in response to the seed weight class. It is evident that decrease in seed weight caused a significant decrease in water uptake of seeds. These results can be explained on the basis that deteriorative changes in membrane systems of the low seed weight class may have occurred. In this respect, **Krieg and Bartee (1974)** mentioned that, low seed weight class absorbed relatively less water than those of high ones.

Table (4): Water uptake% of the initial bean seed fresh weight as affected by seed quality class in both seasons

Seed class	Imbibition time (h)							
	1	2	3	4	5	6	7	8
				1st season				
Light	21.72	39.87	56.58	72.27	84.95	87.04	92.82	105.87
Ungraded	29.00	43.30	67.14	81.65	89.32	90.20	108.37	121.34
Heavy	38.95	50.20	77.49	83.32	97.20	108.54	127.88	147.48
$LSD_{(0.05)}$	**5.17**	**3.03**	**7.89**	**1.72**	**3.37**	**1.31**	**13.01**	**11.10**
				2nd season				
Light	20.95	37.57	58.09	72.18	83.90	86.00	93.88	104.82
Ungraded	29.78	46.11	67.10	78.77	89.61	90.19	108.27	134.41
Heavy	36.11	50.49	78.77	81.65	95.13	114.81	131.01	150.57
$LSD_{(0.05)}$	**5.13**	**3.37**	**6.18**	**4.01**	**3.10**	**2.71**	**8.19**	**13.17**

Conductivity of electrolyte leakage.

Data in Table (5) exhibited that conductivity of electrolytes leakage was significantly and inversely correlated with the seed weight class. In addition, loss of electrolytes from all seed weight classes increased with increasing imbibition time up to 8h. Increasing leakage of light seed weight class may be attributed to enhancement of permeability of cell membrane. It is interesting to note that, the electrical conductivity of electrolyte leakage from seeds was negatively correlated with their vigor, since, the seeds which gave high conductivity were low in vigor and *vice versa*. Similar results were documented by **Bartee and Krieg (1974) and Gadallah (2000)**.

Table (5): Conductivity of electrolytes leakage (EC, dSm^{-1} 100^{-1} seeds) from imbibition bean seeds as affected by seed quality class in both seasons

Seed class	Imbibition time (h)							
	EC (dsm^{-1} 100^{-1} seeds)							
	1	2	3	4	5	6	7	8
				1st season				
Light	0.328	0.560	0.640	0.830	1.050	1.125	1.300	1.361
Ungraded	0.275	0.330	0.575	0.675	1.125	1.263	1.331	1.392
Heavy	0.205	0.363	0.405	0.775	0.830	0.940	1.000	1.050
$LSD_{(0.05)}$	**0.061**	**0.021**	**0.127**	**0.087**	**0.189**	**0.108**	**0.022**	**0.020**
				2nd season				
Light	0.275	0.540	0.645	0.900	1.111	1.200	1.275	1.370
Ungraded	0.322	0.575	0.675	0.872	1.063	1.103	1.200	1.300
Heavy	0.210	0.384	0.452	0.753	0.813	0.908	0.985	1.022
$LSD_{(0.05)}$	**0.038**	**0.027**	**0.029**	**0.022**	**0.039**	**0.078**	**0.061**	**0.053**

Leakage of inorganic solutes.

The influence of seed weight class on inorganic leaked solutes of sodium (Na), potassium (K) and inorganic phosphorus (P_i) was significant during all times of imbibition period of the three tested seed classes; light, ungraded and heavy (Table 6). Light seed weight class, gave the greatest amounts of inorganic solutes; Na, K and P_i while, the heavy seed class attained the least one. Moreover, progressive increases in inorganic leaked solutes of Na, K and P_i was recorded as the imbibition increased up to 8h.

The increased leakage of inorganic solutes with decreasing seed weight class suggests a cellular degradation or increased membrane permeability allowing for rapid efflux the soluble Na, K and P_i salts.

Leakage of organic solutes.

Relative leakage of organic solutes; free amino acids, sugar, and A^o260 and A^o280 absorbing materials (*esp*. proteins and nucleic acids) from the different seed classes is shown in Tables (7&8). The results indicate that the leakage of organic solutes were significantly influenced with seed weight class during all times of imbibition for the tested seed classes (light, ungraded and heavy). It was obvious that leakage of amino acids and sugars were inversely proportional to seed weight class indicating that the lower the seed weight class, the higher the leakage of the free amino acids and sugars. This result may be as a result of membrane dysfunction with decreasing in seed density class (**Krieg and Bratte, 1974**). Measurements of A^o260 and A^o280 absorbing materials (*esp*. proteins nucleic acids) in the imbibiting medium (Table 8), show that these was a linear rate of loss occurred throughout the period of imbibition for all seed classes. The light seeds showing much greater rate of leakage than the other two classes, heavy and ungraded. These results are in accordance with those of **Gadallah (2000)**.

Collectively, these results indicate that the quantity of material available for leaching from the seed was significantly influenced by seed weight. Seed coat and cellular integrity are apparently much less in the low weight (light) seed compared with the higher weight seed (heavy). Thus, the high quantity of soluble compounds leaked from the low weight seeds should provide an ideal media for a rapid growth microorganism.

II. Field study.

Vegetative growth.

Data represented in Table (9) indicate that, all growth characters; plant height, No. of leaves plant^{-1}, leaf area leaf^{-1}, leaf area plant^{-1} and No. of branches plant^{-1} recorded a gradual increase as a result of seed weight increase in both seasons. This increase in these characters from all seed weight classes significantly differed. In this respect, values of plant growth (plant height, No. of leaves plant^{-1}, leaf area leaf^{-1}, leaf area plant^{-1} and No. of branches plant^{-1}) produced from heavy seed class were significantly higher than those of the other two seed weight classes (light and ungraded) in both seasons. In the first season, the increases which recorded by heavy seed class as compared to those of light and ungraded ones reached: 48.60% and 27.26%, 22.43% and 13.77%, 34.65% and 18.63%, 64.85% and 34.97% as well as 50.00% and 24.14%, respectively. In the second one, the increases were: 30.81 % and 15.94 %, 17.16 % and 2.83%, 27.04% and

Table 6, 7

Table 8

8.80%, 51.46% and 20.89% as well as 35.04% and 27.59% for plant height, No. of leaves plant^{-1}, leaf area leaf^{-1}, leaf area plant $^{-1}$ and No. of branches plant^{-1}, respectively. Data shown in Table (10) represented the response of fresh and dry weights of leaves plant^{-1}, fresh and dry weights of branches plant^{-1} as well as fresh and dry weights of shoot plant^{-1} to the three different seed classes used. It could be observed that the previous characters were significantly influenced by seed quality, in both seasons representing their highest values with heavy class of seed. By other means, heavy seed class recorded an increase in the first season: 43.59% and 18.65%, 75.31% and 12.02%, 58.2% and 22.98%, 56.03% and 23.13%, 47.64% and 19.89% as well as 69.43% and 15.59% when compared with the light and ungraded class, respectively. In the second one, the increases reached: 39.87% and 12.33%, 69.03% and 27.61%, 39.85% and 17.59%, 39.86% and 8.50% as well as 59.11% and 21.66%. For fresh and dry weights of leaves plant^{-1}, fresh and dry weights of branches plant^{-1} and fresh and dry weights of shoot plant^{-1}, respectively. It means that the best plant growth was associated with the heaviest seed class. On the contrary, the poorest growth was recorded with light seed class. These findings were true in both seasons. Thus, the differences in initial seed weights among the density classes created a differential degree of growth among the classes of seed. However, these findings confirm that seed quality may affect plant fresh and dry weights during the first stages of development. Most plant tissues involved in the production of dry matter are formed after seedling emergence and it seems unlikely that seed quality would influence their ability to carry out physiological processes and accumulate dry matter during the whole vegetative of development. These informations confirmed the findings of **Tekrony and Egli (1991); Perin *et al*. (2002) and Rodo and Marcos (2003)**.

Table (9): Plant height, No. of leaves plant^{-1}, leaf area leaf^{-1}, leaf area plant^{-1} and No. of branches plant^{-1} of bean as affected by seed quality in both seasons

Seed class	Plant height (cm)	No. of leaves plant^{-1}	leaf area leaf^{-1} (cm^2)	leaf area plant^{-1} (cm^2)	No. of branches plant^{-1}
1st season					
Light	25.35	14.71	88.90	1307.72	6.00
Ungraded	29.60	15.83	100.90	1597.25	7.25
High	37.67	18.01	119.70	2155.80	9.00
LSD$_{(0.05)}$	**3.71**	**0.82**	**8.37**	**113.15**	**0.96**
2nd season					
Light	24.08	14.93	89.50	1336.24	6.85
Ungraded	27.17	16.02	104.50	1674.09	7.25
High	31.50	17.80	113.70	2023.86	9.25
LSD$_{(0.05)}$	**2.82**	**0.79**	**7.82**	**121.09**	**0.33**

Table (10): Fresh and dry weights of leaves plant^{-1}, branches plant^{-1} and shoot Plant^{-1} of bean as affected by seed quality of bean in both seasons

Seed class	Leaves weight plant^{-1} (g)		Branches weight plant^{-1} (g)		Shoot weight plant^{-1} (Leaves & branches, g)	
	Fresh	**Dry**	**Fresh**	**Dry**	**Fresh**	**Dry**
1st season						
Light	14.89	2.34	5.68	1.16	20.57	3.50
Ungraded	18.02	3.66	7.31	1.47	25.33	5.13
High	21.38	4.10	8.99	1.81	30.37	5.91
$LSD_{(0.05)}$	**2.02**	**0.87**	**090**	**026**	**3.92**	**065**
2nd season						
Light	15.50	2.68	6.50	1.38	22.00	4.06
Ungraded	19.30	3.55	7.73	1.76	27.03	5.31
High	21.68	4.53	9.09	1.93	30.77	6.46
$LSD_{(0.05)}$	**0.97**	**0.78**	**0.93**	**0.14**	**2.88**	**0.93**

Green pod yield and its components.

Data concerning No. of green pods plant^{-1}, fresh and dry weights pod^{-1}, total green pods yield plant^{-1} and feddan^{-1} during both seasons as affected seed quality are presented in Table (11). It could be noticed that heavy seed class showed the highest values of the previous parameters as compared to light and ungraded classes is both seasons. On the other hand, the lowest values in this respect were associated with light seed class. However, the variation within the three classes of seed quality was significant for all criteria showed in Table (11). In this respect, it was also found that the superiority of heavy seed class over light and ungraded ones in the first season was: 29.83% and 14.85%, 26.06% and 11.68%, 34.55% and 8.83%, 63.66% and 28.26%, and 63.59% and 28.39%. In the second one the increases reached: 34.07% and 8.93%, 16.89% and 9.85%, 64.00% and 18.84%, 56.71% and 19.66% and 56.66% and 19.66% for No. of total green pods plant^{-1}, fresh and dry weights pod^{-1}, total green pods yield plant^{-1} and feddan^{-1}, respectively. The superiority of heavy seed class for all characters showed in Table (11) was mainly due to the increase its vegetative growth than other classes, which means that heavy seed class resulted in a pronounced increase in the number of leaves, fresh and dry weight plant^{-1}, ….etc, consequently green pod yield and its components is expected to be higher for heavy seed class plants than others. However, green pod yield compensation in plots planted with heavy seed class may have been affected through the increased branching and pod set plant^{-1} and it has also been reported that plants grown from heavy seed class may have greater yielding capacity at uniform stands **(Stivers and Sweeringin, 1978).** Also, The number of green pods plant^{-1} increased with increasing seed weight of faba bean **(Salih, 1983)**.

Table (11): No. of green pods plant^{-1}, fresh and dry weights green pod^{-1} and green pods plant^{-1} of bean as affected by seed quality in both seasons

Seed class	No. of green pods plant^{-1}	Weight green pod^{-1} (g)		Weight of green pods plant^{-1} (g)		Green pods yield feddan^{-1} (ton)
		Fresh	Dry	Fresh	Dry	
1st season						
Light	11.5	6.60	0.46	75.90	5.29	4.34
Ungraded	13.0	7.45	0.68	96.85	8.84	5.53
High	14.93	8.32	0.74	124.22	11.05	7.10
LSD$_{(0.05)}$	**1.61**	**070**	**0.04**	**6.13**	**2.25**	**1.09**
2nd season						
Light	13.0	6.87	0.50	89.31	6.50	5.10
Ungraded	16.0	7.31	0.69	116.96	11.04	6.68
High	17.43	8.03	0.82	139.96	14.29	7.99
LSD$_{(0.05)}$	**1.07**	**0.41**	**0.17**	**19.08**	**3.72**	**1.01**

Dry seed yield and its components.

Data showing the influence of seed quality on dry seed yield of bean and its components expressed as No. of seeded pods plant^{-1}, No. of empty pods plant^{-1}, No. of seeded dry pod grades **A** (1 seed pod^{-1}), **B** (2 seeds pod^{-1}), **C** (3 seeds pod^{-1}), **D** (4 seeds pod^{-1}), **F** (5 seeds pod^{-1}), total number of dry seeds plant^{-1}, total dry seed yield plant^{-1} and feddan^{-1} and 100-seed weight (seed index) are presented in Table (12).

Number of empty, seeded and total dry pods.

Data in Table (12) show that No. of empty, seeded and total dry bean pods significantly responded to the seed quality in both seasons. The comparison among the three investigated seed classes of bean within each aforementioned trait showed that the heavy seed class significantly resulted in less number of empty dry bean pods and more number of seeded and total dry bean pods than those achieved with other seed quality classes. In this respect, the decrease in No. of empty dry bean pods recorded by the heavy seed class as compared to the light and ungraded ones were: 39.34% and 15.91%, respectively in the first season, while reached: 42.02% and 15.58%, respectively in the second season. The increases in No. of seeded and total dry bean pods recorded by the heavy seed class as compared to the light and ungraded ones reached: 50.19% and 21.69%, respectively in the first season while in the second one were: 64.96% and 30.05%, respectively.

Number of seeded dry bean pod grades (A-E).

The results presented in Table (12) reflect the influence of seed quality on number seeded bean pod grades; A-E in both seasons. Comparisons between means of the three seed quality classes showed a significant difference in the No. of seeded dry bean pods grades; A-E and the trend was exactly the same in both seasons. In this respect, the heavy seed class significantly gave the greatest number of seeded dry bean pod grades (A-E) as compared to the other classes; light and ungraded ones. The corresponding increments in No. of seeded dry bean pods grades (A-E) by the heavy seed class over the light and ungraded ones were: 52.13% and

Table 12

16.26%, 20.36% and 10.33%, 68.07% and 16.96%, 35.47% and 10.84%, as well as 36.04% and 29.06% in the first season and 99.25% and 18.67%, 32.93% and 11.99%, 32.29% and 17.23%, 50.00% and 15.68% and 49.07% and 21.05%, in the second season for grades of A, B, C, D and E respectively.

No. of seeds plant^{-1}, dry seed yield plant^{-1} and feddan^{-1} and seed index.

The influence of seed quality class; light, ungraded and heavy on No. of seeds plant^{-1}, seed yield plant^{-1} and feddan^{-1} and seed index in both seasons are shown in Table (12). Seed class differences in the previous mentioned characters were significant and the heavy seed class was superior to the other in this regards. Differences between the heavy seed class, light and ungraded classes were: 41.73% and 14.24% and 43.78% and 16.22%, respectively for No. of seeds plant^{-1}, 86.16% and 30.95% and 88.39% and 31.13%, for dry seed yield plant^{-1} as well as 86.86% and 30.79%, 88.19% and 31.05% for seed yield feddan^{-1} as well as 29.12% and 12.86% and 31.23% and 12.77% for seed index in the first and second seasons for light and ungraded classes, respectively. Thus, seed yield and its components was significantly correlated with planted seed quality. The advantage of graded seed might be explained by the theory of **Fontes and Ohlrogge (1972)** that ungraded soybeans may produce lower yields than graded seed because plants from large seed suppress plants from small seeds. Generally, crop yield is the product of the interaction of a large number of genetically controlled physiological processes and morphological components that evolved in sequential developmental patterns **(Al-Mukhtar and Coyne, 1981)**. It is well Known that enhanced seed quality results in improved field emergence which often leads to increased yield **(Johnson and Mulvaney, 1980)**. **Fernandez and Miller (1985) and Westermann and Crothers (1977)** mentioned that seed yield in legumes was determined by 3 major yield components, i.e. pods plant^{-1}, seeds pod^{-1} and seed weight. The highest seed yield was obtained when all were maximized. In addition, the increasing seed weight led to increase in seed yield and 1000-seed weight of pea **(Ondrej, 1984),** seed yield plant^{-1}, weight and No. of seeds pod^{-1} of cowpea **(Yadava, 1990),** seed yield of bean **(Das and Chatterjee, 1992)** and seed yield of soybean **(Zaimoglu *et al*., 2004)**. Hence an increase in seed yield must be accompanied by an increase in at least one of these components. However, because these components were interrelated and both physiological and morphological aspects of plant growth and development were believed to influence these components, an increase in one might always result in increased yield. Thus, the current results confirm the above mentioned findings. These findings, generally, indicated that the heavy seed class was favourable and resulted in the best performance in this regards.

Chemical constituents.

In leaves.

Changes in some chemical constituents; leaf pigments (chlorophyll a, b and total as well as carotenoids), total sugars (TS), protein, macro-nutrients (N, P and K) and micro-nutrients (Fe, Mn and Zn) in leaves of plants produced from the different seed quality classes are shown in Tables (13&14). Under different seed quality classes, increasing seed weight resulted in a gradual increase in the values of chemical constituents. The highest values of those constituents were recorded with the plants of heavy seed class. Whereas, the lowest values resulted from plants of light seed class. However, the variation within the three seed quality classes was significant for all chemical constituents showed in Tables (13&14). In this regard, the increases which recorded by the heavy seed class over the light and ungraded ones reached: 142.73% and 35.88%, 132.25% and 29.41%, 98.03% and 15.17% and 77.60% and 21.79% in the first season for chlorophyll a, b and total as well as carotenoids, respectively while, in the second one the increases were: 134.32% and 23.68%, 108.11% and 11.29%, 116.93% and 17.61% and 75.00% and 24.44%, for the above mentioned parameters as stated before. In a like manner, the highest values of TS, protein, N, P, K, Fe, Mn and Zn concentrations in leaves of bean were detected with plants produced from the heavy seed class in both seasons than those of other two classes; light and ungraded (Table 14). In this respect, the differences between the three seed classes were statistically significant in both seasons. The corresponding increase in the above mentioned chemical constituents by the heavy seed class over the light and ungraded ones were: 34.34% and 21.09% in TS, 35.66% and 11.82% in protein, 35.68% and 11.58% in N, 39.58% and 13.56% in P, 42.51% and 30.53% in K, 17.40% and 7.14% in Fe, 30.54% and 9.11% in Mn and 13.82% and 7.10% in Zn concentration in the first season. Whereas, in the second one the increases reached: 39.71% and 18.75% in TS, 32.49% and 16.36% in protein, 33.77% and 16.41% in N, 40.68% and 13.70% in P, 31.70% and 23.90% in K, 24.26% and 10.27% in Fe, 29.67% and 13.99% in Mn and 11.26% and 5.83% in Zn concentration.

Table (13): Leaf pigments; chlorophyll a, b, total and carotenoids (mg g^{-1} fresh weight of bean leaves) as affected by seed quality of bean in both seasons

Seed class	Leaf pigments (mg g^{-1} fresh wt. of leaves)			
	a	b	T	carotenoids
1st season				
Light	0.805	0.648	1.576	0.192
Ungraded	1.438	1.163	2.710	0.280
High	1.954	1.505	3.121	0.341
$LSD_{(0.05)}$	**0.413**	**0.287**	**0.377**	**0.051**
2nd season				
Light	0.711	0.592	1.382	0.224
Ungraded	1.347	1.107	2.549	0.315
High	1.666	1.232	2.998	0.392
$LSD_{(0.05)}$	**0.248**	**0.111**	**0.369**	**0.061**

Table (14): Chemical constituents concentration; N, P, K, Fe, Mn and Zn, protein and total sugars (TS) in bean leaves as affected by seed quality of bean in both seasons

Seed class	N	P	K	Fe	Mn	Zn	protein	TS
	(%)	(mg 100^{-1}g dry matter of leaves)					(%)	
				1^{st} season				
Light	2.13	24.0	207.0	17.64	5.14	8.61	13.32	2.65
Ungraded	2.59	29.5	226.0	19.33	6.15	9.15	16.16	2.94
High	2.89	33.5	295.0	20.71	6.71	9.80	18.07	3.56
$LSD_{(0.05)}$	**0.21**	**4.01**	**11.17**	**1.17**	**0.32**	**0.35**	**1.72**	**0.46**
				2^{nd} season				
Light	2.28	29.5	214.5	16.16	5.53	10.12	14.25	2.72
Ungraded	2.62	36.5	228.0	18.21	6.29	10.64	16.38	3.20
High	3.05	41.5	282.5	20.08	7.17	11.26	19.06	3.80
$LSD_{(0.05)}$	**0.43**	**3.91**	**10.70**	**1.03**	**0.69**	**0.41**	**1.09**	**0.49**

In green pods.

Regarding the changes of chemical constituents in green pods of bean, data presented in Table (15), show that there are significant differences between the different seed classes in both seasons for TS, protein, N, P, K, Fe, Mn and Zn concentrations. It is clear that the heavy class of seed resulted in a marked increase in the levels of those chemical constituents over that of light and ungraded classes. This finding seems to indicate that chemical constituents of green pods affected by seed quality class. However, the increases recorded by the heavy seed over light and ungraded classes were 37.76% and 22.05% in TS , 28.91% and 3.76% in protein, 28.48% and 3.74% in N, 23.71% and 13.21% in P, 16.12% and 5.62% in K, 13.84% and 11.04% in Fe, 27.18% and 18.02% in Mn and 37.91% in Zn concentration in the first season. Meanwhile, in the second one increases reached: 39.84% and 22.86% in TS , 32.12% and 10.75% in protein, 32.11% and 10.75% in N, 22.83% and 11.88% in P, 23.38% and 8.26% in K, 19.21% and 5.88% in Fe, 31.48% and 17.36% in Mn and 40.74% and 21.91% in Zn concentration.

Table (15): Chemical constituents concentration; N, P, K, Fe, Mn and Zn, protein and total sugars (TS) in dry matter of bean green pods as affected by seed quality of bean in both seasons

Seed class	N	P	K	Fe	Mn	Zn	protein	TS
	(%)	(mg 100^{-1}g dry matter of green pods)					(%)	
				1^{st} season				
Light	1.51	97	291.5	0.795	1.03	14.64	9.41	2.41
Ungraded	1.87	106	320.5	0.815	1.11	17.71	11.69	2.72
High	1.94	120	338.5	0.905	1.31	20.19	12.13	3.32
$LSD_{(0.05)}$	**0.04**	**6.13**	**11.17**	**0.67**	**0.14**	**1.31**	**0.40**	**0.25**
				2^{nd} season				
Light	1.56	92	305.8	0.755	1.08	14.63	9.75	2.46
Ungraded	1.86	101	348.5	0.850	1.21	16.89	11.63	2.80
High	2.06	113	377.3	0.900	1.42	20.59	12.88	3.44
$LSD_{(0.05)}$	**0.15**	**7.01**	**15.01**	**0.031**	**0.16**	**2.13**	**0.32**	**0.18**

In dry seed.

Data presented in Table (16) show that a high quality of bean seed resulted in a marked increase in level of the chemical constituents in dry seeds; Total soluble carbohydrates (TSC), protein, N, P, K, Fe, Mn and Zn. The increase affect was more pronounced in the dry seeds of heavy seed class which had been a significant increase as compared to both of light and ungraded seed classes in both seasons. This increase, in the first season, reached: 12.15% and 5.49% in TSC, 27.30% and 10.89% in protein, 27.16% and 10.86% in N, 43.64% and 16.18% in P, 48.84% and 23.08% in K, 22.22% and 11.59% in Fe, 16.44% and 5.59% in Mn and 27.91% and 10.00% in Zn concentration. Whereas, the increases in the second season, were; 18.69% and 9.18% in TSC, 25.17% and 8.92% in protein, 25.17% and 9.21% in N, 53.85% and 23.08% in P, 53.45% and 23.61% in K, 19.16% and 8.57% in Fe, 12.42% and 4.29% in Mn and 21.88% and 23.53% in Zn concentration. In this respect, larger seed weight positively correlated with seed N, P and K in cowpea **(Kang and Ofeimu, 1993)**.

Table (16): Chemical constituents concentration; N, P, K, Fe, Mn and Zn, protein and total soluble carbohydrates (TSC) in dry seeds of bean as affected by seed quality of bean in both seasons

Seed class	N	P	K	Fe	Mn	Zn	protein	TSC
	(%)	(mg 100^{-1}g dry matter of dry seeds)					(%)	
				1st season				
Light	3.13	55	172	126.0	73.0	43.0	19.54	56.06
Ungraded	3.59	68	208	138.0	80.5	50.0	22.41	59.60
High	3.98	79	256	154.0	85.0	55.0	24.85	62.87
$LSD_{(0.05)}$	**0.30**	**8.12**	**33.15**	**11.01**	**3.07**	**3.67**	**1.92**	**2.03**
				2nd season				
Light	3.22	52	174	143.5	76.5	48.0	20.10	52.10
Ungraded	3.69	65	216	157.5	81.5	52.5	23.10	56.64
High	4.03	80	267	171.0	86.0	62.0	25.16	61.84
$LSD_{(0.05)}$	**0.24**	**10.02**	**37.11**	**10.31**	**3.77**	**6.09**	**1.12**	**3.13**

Finally, based on the consistent results in this study, it is our opinion that weight-grading (separation) of bean seed can be used to improve low quality commercial seed. In addition, it is likely that farmers will obtain a good germination, growth and yield by sowing bean seeds high weight (heavy). It is recommended that high quality seeds must be used to reduced the risk of stand establishment failure and ensure full yield of bean (green pods and dry seeds).

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جودة بذور الفاصوليا وعلاقتها بالقدرة الإنباتية والكفاءة الحقلية

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أجريت هذه الدراسة خلال موسمين متتاليين هما: ٢٠٠٥ و٢٠٠٦ بهدف معرفة تأثير المستويات المختلفة لجودة بذور الفاصوليا على القدرة الإنباتية (دراسة معملية) والنمو والمحصول ومكوناته (محصول القرون الخضراء والبذرة الجافة) تحت ظروف الحقل. ولإنجاز ذلك فقد استخدمت ثلاث فئات بذرية مختلفة الوزن (تم فرزها يدويا) من بذور فاصوليا معتمدة من صنف جيزة ٣: **الفئة الأولى (الخفيفة)**: ويتراوح وزن ١٠٠ بذرة منها (٣٣.٧٩-٣٨.٠٢ جم فى الموسم الأول و ٣٤.٣٩-٣٧.١٣ جم فى الموسم الثانى) **والفئة الثانية (الثقيلة)**: ويتراوح وزن ١٠٠ بذرة منها (٤٧.٢٠-٥٧.٦٠ جم فى الموسم الأول و ٤٨.٧٥-٥٧.١٣ جم فى الموسم الثانى). أما بذور الصنف جيزة ٣ بدون فرز (**الصورة التجارية**) ويتراوح وزن ١٠٠ بذرة منها (٣٧.٧٠-٤٢.٨٥ جم فى الموسم الأول و ٤٠.٠٢-٤٩.٨١ جم فى الموسم الثانى) فقد استخدمت كبذور غير مدرجة للمقارنة. تم زراعة البذور فى الحقل خلال الموسم الصيفى لعامى الدراسة بمزرعة كلية الزراعة- جامعة الفيوم-مصر.

ويمكن تلخيص النتائج المتحصل عليها فيما يلى:

لوحظ وجود ارتباط بدرجة كبيرة ما بين النسبة المئوية لإنبات البذور وظهور البادرات من ناحية وبين جودة البذور من ناحية أخرى، حيث أظهرت البذور ذات الوزن العالى (الثقيلة) معدلات أسرع من حيث انبثاق الجذير وتماثل خروجه مقارنة بالبذور ذات الوزن المنخفض (الخفيفة) والأخرى غير المدرجة. أظهرت البادرات الناتجة من البذور عالية الوزن معدلات عالية بالنسبة لطول الجذير والسويقة الجنينية السفلى ووزن المحاور الجنينية الطازجة والجافة مقارنة بمثيلتها الناتجة من البذور الخفيفة الوزن والأخرى غير المدرجة ويدل ذلك على أن بذور الفاصوليا ذات الوزن العالى (الثقيلة) تنتج بادرات ذات قدرة عالية على النمو. أظهرت معدلات التشرب بالماء ودرجة التوصيل الكهربى وأيضا كمية الذائبات غير العضوية (الصوديوم- البوتاسيوم- الفوسفور) والعضوية (الأحماض الأمينية الحرة – السكريات – وبعض المواد الممتصة على طول موجة ٢٦٠و٢٨٠ نانوميتر) المتسربة من البذور عند تشربها بالماء علاقة عكسية مع وزن البذور مفسراً ذلك بحدوث تأثير ضار للبذور ذات الوزن المنخفض أثناء النضج أو حدوث تدهور بها بعد الحصاد .

لوحظ أن جودة بذور الفاصوليا أثرت بدرجة معنوية على الكفاءة الحقلية لنباتات الفاصوليا مؤدية بدورها إلى زيادة صفات النمو التى تم دراستها (ارتفاع النبات– عدد الأوراق للنبات–

مساحة الورقة – المساحة الورقية للنبات– الوزن الطازج والجاف لأوراق النبات– الوزن الطازج والجاف لفروع النبات– والوزن الطازج والجاف للمجموع الخضرى. وذلك بزيادة درجة جودة البذور. لوحظ وجود علاقة وطيدة بين جودة البذور للفاصوليا ومحصول القرون الخضراء ومكوناته: عدد القرون الخضراء للنبات – وزن القرن– محصول القرون الخضراء للنبات والفدان. حيث زادت هذه الصفات بزيادة درجة جودة البذور. وجد أن محصول البذور الجافة ومكوناته سواء للنبات أو الفدان قد أظهر علاقة إيجابية مع درجة جودة البذور المنزرعة حيث وجد أن النباتات التى أعطت محصول عالى من البذور الجافة كانت ذات درجة جودة عالية. سجلت البذور ذات درجة الجودة العالية زيادة معنوية فى تركيز كل من: السكريات الكلية (الأوراق، القرون الخضراء)– الكربوهيدرات الذائبة الكلية (البذور الجافة)– البروتين– النيتروجين– الفوسفور– البوتاسيوم– الحديد– المنجنيز– الزنك فى الأوراق والقرون الخضراء والبذور الجافة.

وأخيرا، وفى ضوء النتائج السابقة، أن عملية فصل (تدريج) بذور الفاصوليا إلى الفئات السابقة يساعد على تنقيتها بالقدر الذى يسمح بإنتاج بذور ذات قدرة عالية على الإنبات وإعطاء بادرات متماثلة، وأن الجودة العالية لبذور الفاصوليا قد أدت إلى زيادة نسبة الكفاءة الحقلية لنباتات الفاصوليا والتى تؤدى بدورها لزيادة نسبة التماثل والنمو للنباتات النامية فى الحقل وما تبع ذلك من زيادة فى محصول القرون الخضراء والبذور الجافة سواء للنبات أو الفدان. وهكذا فإنه يوصى بقيام المزارعين بزراعة البذور ذات الجودة العالية للحصول على زيادة فى محصول الفاصوليا (القرون الخضراء والبذور الجافة).