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The Impact of Bonavista Bean Types Mixed with Different Grasses on Forage Yield and Quality

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ABSTRACT

This study was conducted to evaluate the potentialities of three Bonavista bean types (*Dolichos lablab,* L.) which were White (WB), Black (BB) and Brown (BRB) seeded coat mixed with three fodder grasses which were pearl millet (PM), Sudan grass (SG) and Sorghum Sudan grass (SSG). Two field experiments were carried out at the Experimental Research station, Faculty of Agriculture, Moshtohor, Benha University, Kalubia Governorate during two growing summer seasons (2011 & 2012). Experiments were designed and implemented to evaluate the specific properties of growth behavior, fresh and dry forage yield and quality as well. Results could be concluded as follows:-

Data indicated significant differences in total fresh and dry forage yield for each of the studied forage crops and their mixtures. Highest productive fresh and dry forage were obtained for Sorghum Sudan grass, whereas, the lowest values were recorded for Black Bonavista bean with significant differences of variable magnitudes in their pure stand. The highest values of Leaf:Stem ratio and crude fiber (CF) content were obtained for White B.bean type. Also, Sudan grass was of the highest number of shoots/m^2 and the tallest plants as well. Meanwhile, Brown B.type was of the CP highest content as compared with the other tested forages with significant differences.

Concerning the proposed mixtures, the highest values were obtained for fresh forage yield, dry yield, number of shoots/m^2, Leaf: Stem ratio, Plant height, CP and CF were ranked in the following descending order as follows: SG+BB, SG+BRB, PM+BRB, SG+BRB, SSG+BRB, SSG+WB and SG+BB, respectively with significant differences magnitudes.

Key words: Bonavista Bean, forage mixtures, forage quality

Introduction

Among the national future plans of increasing food and feed potentialities in Egypt is paying considerable attention for enhancing agricultural production and quality at reasonable alternative sustainable agronomic practices. In this regard, the severe lack in production of forage crops all year round, especially during summer seasons where there is no available source of leguminous forage crops high protein content to be grown. Moreover, there are almost no certified commercial sources of forage seeds of CP content especially during summer season.

Among the available herbaceous forage legumes are Bonavista bean (*Dolichos lablab,* L.) of different types according to the seed-coat color and their relevant interaction with their companion fodder grasses mixtures as pearl millet, Sudan grass and Sorghum Sudan grass which are expected to induce additive performance values in respect of nitrogen fixation and the extra other interacted beneficial advantages of such legumes and grasses mixtures which were of great concern in this study.

In this connection, Mokoboki *et al.* (2000) noticed significant varietal effect of cowpeas (*Vigna sinensis,* L.) on its chemical composition. Crude protein content is an important factor of forage quality. Jilani *et al.* (2001) investigated four legume species included lablab. Odunsi (2003) studied the performance of nutrient digestibility of lablab (*Lablab purpureus*). He indicated that the constituent analysis proved that lablab contain 234.0 crude protein, 19.0 ether extract, 83.4 crude fiber, 116.0 ash and 467.0 g kg-1 nitrogen free extracts. Foster *et al.* (2009) evaluated 3 forage legumes (soybean, cowpea and pigeonpea) for their Leaf / stem ratio which decreased with maturity and was greater for cowpea than the other tested legumes. Also, several workers (Abd El-Gawad *et al.* (1990), Abou Deya *et al.* (1990), Mohanpillai *et al.* (1990), Abd El–Aal *et al.* (1991), Abd EL-Gawad *et al.* (1992), Nor El-Din *et al.* (1992), Sood and Sharma (1992), Mohamed (1992), Dubey et al. (1995), Sudhaker et al. (1996), Haggag (1998), Abd El-Salam (2002), Zeidan *et al.* (2003), Singh *et al.* (2003), Ibrahim *et al.* (2006), Mohammed *et al.* (2008) and Geren *et al.* (2008)) proved that intercropping legumes with grasses increased fresh forage yield, dry yield , number of branches/plant, leaf:stem ratio, plant height, CP and CF of the mixtures than in the pure stands.

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The main target of this investigation is to evaluate the specific properties of growth behavior, forage yield and quality of the proposed indigenous-native herbaceous fodder legumes as Bonavista bean and common fodder grasses in their pure stands and their relevant mixtures of 50:50% ratio.

Materials and Methods

Two field experiments were carried out at the Experimental Research Station, Faculty of Agriculture, Moshtohor, Benha University, Kalubia Governorate during two summer seasons (2011 & 2012) to evaluate the specific properties of the growth behavior, forage yield and quality of some of the indigenous native herbaceous legumes as Bonavista bean types (White, Black and Brown seeded coat), and summer common fodder grasses (pearl millet, Sudan grass and Sorghum Sudan grass) in their pure stands and their relevant propose at 50:50% mixtures.

Experimental design was layed out in a complete randomized block design (CRBD) with four replicates in each of the two seasons. The pure stands and their relevant forage mixtures were distributed randomly in blocks. Each experimental unit was 10.5 m2 (3 x 3.5 m) of about 1/400 feddan area. Two individual cuts were evaluated during each of the two summer growing seasons. Combined analysis of the two season was done after insuring the validity of partlet test (Steel and Torrie ,1981). The applied treatments were:

Bonavista bean types:

1-Bonavista bean (*Dolichos lablab*, L.) of White seed-coat.
2-Bonavista bean (*Dolichos lablab*, L.) of Black seed-coat.
3-Bonavista bean (*Dolichos lablab,* L.) of Brown seed-coat.

Common summer forage grasses:

1- Sorghum Sudan grass (*Sorghum bicolor*, L). var. Mabrouk.
2- Pearl millet (*Pennisetum americanum,* L).var. Shandwil 1.
3- Sudan grass (*Sorghum sudanense,* L). var. Giza 2.

Seeds of each of the three summer forage legumes were brought from indigenous-native regions of Upper Egypt (Aswan). Meanwhile, Seeds of each of the three summer forage grasses were provided from the Forage Department, Agriculture Research Center, Ministry of Agriculture at Giza, Egypt. The recommended seeding rates of each of the above forage crops were properly practiced. Seeds were sown on May, 19th in 2011 and 2012 seasons. Phosphorus fertilizer was applied in form of calcium super phosphate (15.5% P_2O_5) at a rate of 150 kg/feddan during the appropriate soil preparation and before sowing. The recommended seeding rate for each of the above forage crops was followed in the assigned mixtures at a ratio of 50%: 50 % .
Studied parameters: Two subsequent cuts were devoted for each of the two growing seasons (2011&2012). The first cuts were obtained at 60 days from sowing and the second one was obtained at 40 days later.

Appreciated symbol, seeding rates in pure stands and the proposed mixtures of Bonavista bean types and various forage grasses are presented in the following chart:

			Symbol Appreciated	Seeding rates (kg/fed)
Pure stands:				
Legumes	1	White Bonavista bean	(WB)	20
	2	Black Bonavista bean	(BB)	20
	3	Brown Bonavista bean	(BRB)	20
Fodder grasses	4	Pearl millet	(PM)	20
	5	Sorghum Sudan grass	(SSG)	20
	6	Sudan grass	(SG)	20
Relevant mixtures (50:50 %):				
Relevant mixtures 50:50 %	7	Pearl millet + White Bonavista bean	(PM +WB)	10+10
	8	Pearl millet + Black Bonavista bean	(PM + BB)	10+10
	9	Pearl millet + Brown Bonavista bean	(PM + BRB)	10+10
	10	Sorghum Sudan grass + White Bonavista bean	(SSG +WB)	10+10
	11	Sorghum Sudan grass + Black Bonavista bean	(SSG + BB)	10+10
	12	Sorghum Sudan grass + Brown Bonavista bean	(SSG + BRB)	10+10
	13	Sudan grass + White Bonavista bean	(SG +WB)	10+10
	14	Sudan grass + Black Bonavista bean	(SG + BB)	10+10
	15	Sudan grass + Brown Bonavista bean	(SG + BRB)	10+10

Table 1: The prevailing climatic factors at Kalubia Governorate during each of the two growing seasons.

Season	First season (2011)					Second season (2012)				
Climatic factors / Month	Soil Temp. (C°)	Solar radiation (w/m^2)	Wind speed (m/sec)	Air Temp. (C°)	Dew Point (C°)	Soil Temp. (C°)	Solar radiation (w/m^2)	Wind speed (m/sec)	Air Temp. (C°)	Dew Point (C°)
1-15 June	27.1	252.7	1.42	24.9	16.1	29.9	255.3	1.60	25.5	16.7
16-30 June	28.0	245.1	1.51	24.9	16.8	30.2	241.6	1.00	27.5	20.3
1-15 July	32.56	243.9	1.26	26.4	19.1	30.6	238.8	1.00	27.9	20.8
16-31 July	31.8	245.7	1.12	27.4	21.2	30.3	228.2	0.75	27.7	22.9
1-15 August	30.1	229.4	1.00	26.6	20.7	27.7	207.0	0.60	28.8	22.7
16-31 August	28.8	181.3	0.63	25.3	20.3	28.6	193.8	0.50	28.5	19.3
1-15 September	27.1	132.8	0.89	23.8	18.8	28.7	164.6	0.80	23.9	20.1
16-30 September	26.7	196.6	0.84	24.1	18.2	28.2	154.4	0.60	24.6	17.9

Vegetative growth characteristics:

Ten plants were randomly selected from each experimental unit in each of the two seasons for studying the following parameters: Plant height (cm); Leaf / stem ratio which estimated on fresh weight basis and Number of shoots/m^2.

Fresh and dry forage yield:

Fresh forage yield in each experimental unit of the grown forage crop plants under study was determined for each of the subsequent cuts and for each of the two studied seasons and recorded using field scale of 0.5 kg sensitivity then forage yield was estimate and recorded in ton / fed.

For determining the dry matter content and estimated the total dry yield: samples of about 200 gm of fresh forage were selected randomly from each experimental unit just before cutting the whole experimental plot, accurately weighted using an electric balance of 0.01 gm sensitivity. Such obtained fresh samples were dried in an air forced drying oven at 105°C for 3 hours till constant weight to determine the dry matter content. Then, dry yield per feddan was estimated, accordingly.

For chemical analysis:

Chemical analysis was conducted and presented on dry matter basis. Fresh forage samples were randomly taken (through quadrate of ¼ sq meters) from each experimental unit. Samples of the proposed treatments were properly prepared. Accurately weighed samples of the fresh forage of about 200 gm were dried using an air forced drying oven at 75°C till a constant weight. Samples were dried in a labeled Kraft paper bags which were laid in an air forced drying oven all over the drying period. Dried samples were then cooled at room temperature, ground finely and screened using hummer mill of 40 michs. Prepared samples were kept in sealed labeled plastic bags and stored in the refrigerator at 5°C till needed for the chemical analysis.

Samples of each two replicates for each treatment were mixed thoroughly to form two composite samples out of the 4 replicates. Out of each of the two composite samples, two analysis were conducted (for each treatment), then the average results of each analysis in the study were recorded.

Chemical analysis: Forage quality components included the following:

Crude protein (CP) content:

Total nitrogen percentage was determined according to the modified micro kjeldahl method. Crude protein content was estimated by multiplying nitrogen percentage by 6.25 (A.O.A.C., 1995).

Crude fiber (CF) content:

Crude fiber percentage was determined according to the A.O.A.C. (1995).

Statistical analysis:

The analysis of variance for each of the two growing seasons and their combined analysis was conducted after insuring the validity of partlet test according to the procedure described by Steel and Torrie (1981). The L.S.D. test at the 5% level was used in means comparison.

Results and Discussion

Fresh forage yield:

In comparing the total fresh forage yield of pure Bonavista bean types, it is clear from the combined analysis (Table 2) that there were appreciable differences among the grown B.bean types in their fresh forage yield with variable significant magnitudes. White B.type was of the highest in fresh forage yield (24.33) followed by Brown B.type (22.93), then Black B.type (19.40 ton/fed.) with significant differences.

Also, Results showed that there were appreciable differences among the grown grasses in their fresh forage yield significantly. Sorghum Sudan grass was of the superior fresh forage yield (32.2) followed by Sudan grass (30.4) then Pearl millet (29.47 ton/fed) with significant differences (Table 2).

Combined analysis showed that mixtures production of each the three previous grasses with each of the three Fodder legumes could be ranked in a descending order for their fresh forage production as follow: SG+BB $_{(29.20)}$ > SG+BRB $_{(29.20)}$ > SSG+BB $_{(27.27)}$ > SSG+WB $_{(27.20)}$ > SSG+BRB $_{(26.33)}$ > SG+WB$_{(25.67)}$ > PM+BRB $_{(23.26)}$ > PM+WB $_{(22.20)}$ > PM+BB $_{(21.67\ ton/fed.)}$, with significant differences among the subsequent order. In this respect, it is more likely recommended that either of the two superior mixtures SG +BB and SG +BRB were the best combinations of total fresh forage production. Similar comparative studies were conducted by Abd El Gawad *et al.* (1990) for intercropped Sordan with cowpea, Abo Deya *et al.* (1990) for intercropped Sordan with cowpea, Mohanpillai *et al.* (1990) for intercropped maize with cowpea, , Abd El Aal *et al.* (1991) for intercropped Sordan with guar, Abd El Gawad *et al.* (1992) for intercropped Sudan grass with cowpea, Nor El Din *et al.* (1992) for intercropped Pearl millet with guar, Sood and Sharma (1992) for intercropped sorghum with cowpea, Dubey *et al.* (1995) for intercropped sorghum with soybean and Geren *et al.* (2008) for intercropped maize with cowpea.

Moreover, seasonal variations exerted significant difference in fresh forage yield among the tested Bonavista bean types (Table 2). Results indicate that white type of Bonavista bean was significantly the highest in total fresh forage yield compared to each of other two types. These results were true in each of the two growing seasons. It is also noticed that each of the three tested B.bean types produced relatively higher total forage yield in the first season than the second one.

Concerning fodder grasses, total fresh forage yield productivity could be ranked in the following descending order: Pearl millet(29.2), then Sorghum Sudan grass (27.86) followed by Sudan grass (25.73 ton/fed.) in the first season, being Sorghum Sudan grass (36.53) then Sudan grass (35.07) followed by Pearl millet (29.73 ton/fed.) in the second season.

Regarding the proposed mixtures results indicated that fresh forage production of the proposed mixture was of much more magnitudes during the second season compared with the first one with significant differences (Table 2).

Table 2: Fresh forage yield of legumes, grasses and their proposed mixtures.

Pure & Mixtures	Forages*	First summer season (2011)			Second summer season (2012)			Combined (over growing seasons)		
		1st cut	2nd cut	Total	1st cut	2nd cut	Total	1st cut	2nd cut	Total
		(Ton. / fed.)								
Pure stands	PM	21.60	7.60	29.20	18.93	10.80	29.73	20.27	9.20	29.47
	SG	18.00	7.73	25.73	25.07	10.00	35.07	21.53	8.87	30.40
	SSG	18.93	8.93	27.86	24.13	12.40	36.53	21.53	10.67	32.20
	W B	9.73	17.20	26.93	8.67	13.07	21.74	9.20	15.13	24.33
	B B	6.93	12.27	19.20	6.93	12.67	19.60	6.93	12.47	19.40
	BR B	8.93	15.60	24.53	8.53	12.80	21.33	8.73	14.20	22.93
Relevant mixtures (50 + 50 %)	PM + W B	9.33	8.93	18.26	11.47	14.67	26.14	10.40	11.80	22.20
	PM + B B	8.27	10.13	18.40	10.53	14.40	24.93	9.40	12.27	21.67
	PM + BR B	7.73	10.00	17.73	12.53	16.27	28.80	10.13	13.13	23.26
	SG + W B	9.33	11.47	20.80	15.47	15.07	30.54	12.40	13.27	25.67
	SG + B B	9.20	9.33	18.53	23.33	16.53	39.86	16.27	12.93	29.20
	SG + BR B	8.80	10.80	19.60	21.60	17.20	38.80	15.20	14.00	29.20
	SSG + W B	8.40	11.87	20.27	17.07	17.07	34.14	12.73	14.47	27.20
	SSG + B B	7.47	11.73	19.20	20.13	15.20	35.33	13.80	13.47	27.27
	SSG + BR B	9.73	10.53	20.26	14.93	17.47	32.40	12.33	14.00	26.33
LSD at: 5% for:		F= 1.37	F=1.38		F= 2.01	F= 1.98		F= 1.19 Y= 0.86 FY= 1.68	F= 1.18 Y= 0.71 FY= 1.67	

** PM = Pearl millet, SG = Sudan grass, SSG = Sorghum Sudan grass, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean*

Legumes:	Mixtures
WB (24.33) > BrB (22.93) > BB (19.4)	SG+BB (29.20) > SG+BRB (29.20)> SSG+BB (27.27) > SSG+WB (27.20) > SSG+BRB (26.33) > SG+WB (25.67) > PM+BRB (23.26)> PM+WB (22.20) >PM+BB (21.67 ton/fed.)
Grasses:	
SSG (32.2) > SG (30.4) > PM (29.47)	

Also, concerning variations of cuts the total fresh forage yield was generally higher in the second cuts than the first ones for all of the tested B. bean types with different significant magnitudes. This trend was clear during each of the two growing seasons of fresh yield as it is clear in Table (2). Meanwhile, opposite trend was noticed for the three tested grasses as compared with the indigenous legumes. These results could be attributed to the ecophysiological variations required for such indigenous legumes prevailing in Upper Egypt as compared with the fodder grasses. In this respect, Sorghum Sudan grass was the highest in total forage production for the first cut and the lowest one in production of the second cut for the grasses. Meanwhile, the White Bonavista bean was the highest in total forage production as compared the other two B.bean types during the first cut. Moreover, Black Bonavista bean was of the lowest one during the second cut (Table 2). It looks to be true that the obtained specific significant differences in total fresh yield for each of the grown grasses and legumes was indeed due to their individual specific genetical make up that interact differently with the prevailing environmental conditions of this study in various specific patterns (Table 1).

Generally the highest total fresh forage yield was obtained in the pure stand of Sorghum Sudan grass (grasses) and White B.bean (legumes).meanwhile, in the mixture the highest total yield was SG +BB.

Dry forage yield:

Data for dry forage yield of the proposed forage mixtures and their relevant pure stands during the two successive seasons and their combined analysis are presented in Table (3).Such data represent the dry yield of each the two cuts of and the accumulated total yield of each season and their combined analysis as well.

It is also clear from the combined analysis that there were appreciable differences among the grown B.bean types for their dry forage yield during each of the two growing seasons with variable significant magnitudes. White B.type was of the highest dry yield (3.63) followed by Brown B.type (3.30), then Black B.type (3.01 ton/fed.) with significant differences.

Also, it should be pointed out that, the combined analysis cleared that there were appreciable differences among the grown grasses in their dry yield during each of the two growing seasons significantly. Sorghum Sudan grass was of the highest dry yield followed by Sudan grass, then Pearl millet with significant differences. The respective ranking order for dry yield was 5.73, 5.55 and 4.54 ton/fed. This trend was clear during each of the two growing seasons (Table 3).

Combined analysis clarified that mixtures productivity of the three previous grasses with the three indigenous-native legumes could be ranked in descending order as follow: SG+BRB (4.78) > SSG+WB (4.66) > SG+BB (4.53) > SSG+BB (4.44) > SG+WB (4.28) > SSG+BRB(3.98) > PM+BRB (3.81) > PM+WB (3.63) > PM+BB (3.47 ton/fed.), with significant differences among the subsequent order. It is more likely noticed that either of the two superior mixtures SG+BRB and SSG +WB were the best combinations in total dry forage production. The currently presented results of the behaviour of dry forage productivity of fodder crops and their mixtures were more or less similar to those reported by Haggag (1998) for sorghum with cowpea, Zeidan *et al.* (2003) for fodder maize with cowpea and Ibrahim *et al.*(2006) for maize with cowpea.

Seasonal variation exerted significant difference in dry yield among the tested Bonavista bean types (Table 3). Data showed that white type of Bonavista bean was significantly the highest in the total dry yield compared to each of other two types. These results were true in each of the two growing seasons with slight variable magnitudes. Concerning fodder grasses, results in Table (3) show that dry yield productivity could be ranked in the following descending order: Sorghum Sudan grass (4.75), then Pearl millet (3.91) followed by Sudan grass (3.72 ton/fed.) in the first season, being Sudan grass (7.36) then Sorghum Sudan grass (6.71) followed by Pearl millet (5.16 ton/fed.) in the second season. It is also noticed that all of the three tested B.bean types and fodder grasses produced relatively higher total dry yield in the second season than the first one. Results obviously indicated significant superiority of the total dry forage yield for the grown grasses varieties than B.bean types for the first and second seasons (Table 3). A long the same line, the dry yield production of the proposed mixture was of much more higher magnitudes during the second season compared with the first one with significant differences.

Combined analysis revealed that the total dry yield was generally higher in the second cuts than the first ones for all of the tested B. bean types with different significant magnitudes (Table 3). Opposite trend was

noticed for grasses which was higher in the first cuts than the second ones for all of the three tested grasses with various significant magnitudes. Sudan grass was the highest in total dry production for the first cut and the lowest one in production of the second cut for the other grasses. Meanwhile, the White Bonavista bean was the highest in total dry production as compared the other two B.bean types during the first cut. Moreover, Black Bonavista bean was the lowest one during the second cut (Table 3).

Table 3: Dry yield of legumes, grasses and their proposed mixtures.

Pure & Mixtures	Forages*	First summer season (2011)			Second summer season (2012)			Combined (over growing seasons)		
		1st cut	2nd cut	Total	1st cut	2nd cut	Total	1st cut	2nd cut	Total
		(ton. / fed.)								
Pure stands	PM	2.62	1.29	3.91	2.41	2.75	5.16	2.52	2.02	4.54
	SG	2.44	1.28	3.72	4.81	2.55	7.36	3.63	1.92	5.55
	SSG	2.79	1.96	4.75	3.13	3.58	6.71	2.96	2.77	5.73
	W B	1.12	2.43	3.55	1.08	2.63	3.71	1.10	2.53	3.63
	B B	0.84	1.76	2.6	1.00	2.42	3.42	0.92	2.09	3.01
	BR B	1.08	1.88	2.96	1.07	2.59	3.66	1.07	2.23	3.3
Relevant mixtures (50 + 50 %)	PM + W B	1.34	1.42	2.76	1.43	3.08	4.51	1.38	2.25	3.63
	PM + B B	1.12	1.41	2.53	1.46	2.97	4.43	1.28	2.19	3.47
	PM + BR B	0.97	1.57	2.54	1.59	3.48	5.07	1.28	2.53	3.81
	SG + W B	1.11	2.02	3.13	2.26	3.18	5.44	1.68	2.60	4.28
	SG + B B	1.28	1.47	2.75	2.62	3.69	6.31	1.95	2.58	4.53
	SG + BR B	1.10	1.76	2.86	3.08	3.63	6.71	2.09	2.69	4.78
	SSG + W B	0.99	1.87	2.86	2.59	3.87	6.46	1.79	2.87	4.66
	SSG + B B	0.96	1.95	2.91	2.59	3.40	5.99	1.77	2.67	4.44
	SSG + BR B	1.13	1.57	2.70	1.80	3.47	5.27	1.46	2.52	3.98
LSD at: 5% for:		F= 0.22	F= 0.28		F= 0.39	F= 0.48		F= 0.24 Y= 0.11 FY= 0.33	F= 0.26 Y= 0.17 FY= 0.37	

** PM = Pearl millet, SG = Sudan grass, SSG = Sorghum Sudan grass, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean.*

Legumes:
WB (3.63) > BB (3.3) > BRB (3.01)
Grasses:
SSG (5.73) > SG (5.55) > PM (5.54)

Mixtures

SG+BRB (4.78) > SSG+WB (4.66) > SG+BB (4.53) > SSG+BB (4.44) > SG+WB (4.28) > SSG+BRB (3.98) > PM+BRB (3.81) > PM+WB (3.63) > PM+BB (3.47 ton/fed.),

It should be pointed out that the obtained specific significant differences in dry yield for each of the grown grasses was indeed due to their individual specific genetical make up that interact differently with the prevailing environmental conditions of this study in various specific patterns (Table 1). Similar results were reported by Mokoboki *et al.* (2000) and Jilani *et al.* (2001).

Number of shoots / m^2:

Number of shoots/m^{2}of the proposed forage mixtures and their relevant pure stands as it is clear from the combined analysis are presented in Table (4).

Results of the combined analysis did not exert appreciable significant differences among the studied Bonavista bean types. The White type was of the highest number of shoots/m^2 (11.66 shoots/m^2), whereas, Brown and Black Bonavista bean produced almost similar numbers of shoots/m^2 which was 10.67 and 9.67 shoots/m^2, respectively. So, the White type was of about 21% higher in number of shoots/m^2 as compared with the other two types (Brown and Black). Number of shoots/m^2 from the combined analysis exerted significant differences within the three tested grasses varieties. Pearl millet was of the highest shoots number/m^2 as compared with the other two varieties (Sudan grass and Sorghum Sudan grass) with significant differences. So, the respective descending order was pearl millet (124.33) then Sudan grass (106.0) followed by Sorghum Sudan grass (61.33 shoots/m^2) as it is clear from Table (4).

Combined analysis proved that Mixtures number of shoots/m^2 for any of the nine tested forages could be ranked in the following descending order: PM+BRB(65.66) > PM+BB (64.33) > SG+WB (56.33) > SSG+BB (55.33) > SSG+WB (51.00) > SSG+BRB(50.00) > SG+BRB (47.00) > PM+WB (46.66) >SG+BB (45.33 shoots/m^2.

It is more likely recommended that either of the two mixtures PM+BRB and PM + BB were of the best selected combinations regarding number of shoots/m^2. Whereas, increasing number of legume shoots in mixtures increased the nutrition value (TDN and DP) which improved forage quality.

From the combined analysis (Table 4), it is also clear that number of shoots of was much more during the first season compared with the second one. This result could be an addition to the well knows beneficial impact of mixing legumes and grasses (especially for free fixation nitrogen from the ambient air). Moreover, it is noticed that there was quite difference in number of shoots for the first than the later cuts with different behaviour among the grown mixtures. The currently presented results of the behaviour of number of shoots of fodder crops and their mixtures were more or less similar to those reported by Abd El Gawad *et al.* (1990) in their sordan - fodder cowpea mixtures.

Seasonal variations indicated more shoots in the first season than the second one, with slight differences in number of shoots/m^2 among the tested Bonavista bean types (Table 4).

Results indicated that White type of Bonavista bean was the highest in number of shoots/m^2 compared to each of other two types (Brown and Black) in the first season. Meanwhile, the Brown type was of the highest one in the second season. Whereas, similar trend was noticed for grasses varieties in their number of shoots/m^2 among the seasonal variations, where the higher number of shoots/m^2 was noticed during the first season rather than the second one.

Also, the combined analysis proved that number of shoots/m^2 was generally higher in the first cuts than the second one for all of the tested B. bean types with different magnitudes**.**

Combined analysis proved that all of the three varieties of grasses exerted significant higher reduction in number of shoots/m^2 during the second cuts as compared with the first ones with almost similar magnitudes. Moreover, Pearl millet variety was the highest in shoots/m^2 during each of the two cuts and Black B.bean of the lowest number of shoots during the second cut (Table 4).

Table 4: Number of shoots/m^2 of legumes, grasses and their proposed mixtures.

Pure & Mixtures		First summer season (2011)			Second summer season (2012)			Combined (over growing seasons)		
Forages*		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		(# of shoots/m^2)								
Pure stands	PM	202.67	137.33	170.00	88.00	69.33	78.66	145.33	103.33	124.33
	SG	185.33	74.67	130.00	98.67	65.33	82.00	142.00	70.00	106.00
	SSG	50.67	69.33	60.00	62.67	62.67	62.67	56.67	66.00	61.33
	W B	17.33	9.33	13.33	10.67	9.33	10.00	14.00	9.33	11.66
	B B	10.67	9.33	10.00	10.67	8.00	9.33	10.67	8.67	9.67
	BR B	9.33	10.67	10.00	12.00	10.67	11.35	10.67	10.67	10.67
Relevant mixtures (50 + 50 %)	PM + W B	60.00	56.00	58.00	20.00	50.67	35.33	40.00	53.33	46.66
	PM + B B	78.67	69.33	74.00	61.33	48.00	54.66	70.00	58.67	64.33
	PM + BR B	89.33	66.67	78.00	58.67	48.00	53.33	74.00	57.33	65.66
	SG + W B	114.66	50.67	82.66	26.67	33.33	30.00	70.67	42.00	56.33
	SG + B B	53.33	50.67	52.00	42.67	34.67	38.67	48.00	42.67	45.33
	SG + BR B	41.33	58.67	50.00	42.67	45.33	44.00	42.00	52.00	47.00
	SSG + W B	56.00	76.00	66.00	30.67	41.33	36.00	43.33	58.67	51.00
	SSG + B B	82.67	66.66	74.66	37.33	34.67	36.00	60.00	50.67	55.33
	SSG + BR B	70.67	50.67	60.67	32.00	46.67	39.33	51.33	48.67	50.00
LSD at: 5% for:		F= 13.89	F= 14.58		F= 7.25	F= 7.01		F= 7.67 Y= 5.14 FY= 10.84	F= 7.92 Y= 5.67 FY= 11.19	

** PM = Pearl millet, SG = Sudan grass, SSG = Sorghum Sudan grass, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean.*

Generally, it could be concluded that for any of the tested forage legumes and grasses, their first cuts were of more number of shoots than the second cuts. This may clarify the similarity of vegetative growth for such variety as affected by the prevailing environmental conditions which could be quite be different during the earlier than the later stage of growth (Table 1).

Leaf / Stem ratio:

Data in Table (5) clarified that Leaf / Stem ratio on fresh weight basis of the studied forage mixtures and their relevant pure stands as it is clear from the combined analysis.

Combined analysis revealed variable significant differences of leaf /stem ratio for Bonavista bean types among the tested Bonavista bean types. Whereas, the White type was of the highest Leaf / Stem ratio (0.98). Brown and Black B. bean produced similar Leaf: Stem ratio (0.87). So, the White type was of about 13% higher in Leaf / Stem ratio as compared with the other two types (Brown and Black).

Also, summer grasses varieties were of appreciable differences in their Leaf: Stem ratio, the respective Leaf / Stem ratio could be presented in the following descending order in Pearl millet (0.74) then Sorghum Sudan grass (0.52) followed by Sudan grass (0.43) with significant differences (Table 5).

Combined analysis revealed that Mixtures Leaf / Stem ratio for any of the nine tested forages could be ranked in the following descending order: SG+BRB $_{(0.95)}$ > PM+BRB$_{(0.88)}$ > SSG+BRB$_{(0.69)}$ > PM+WB $_{(0.64)}$ > SSG+WB $_{(0.58)}$ > PM+BB $_{(0.54)}$ > SG+WB $_{(0.54)}$ > SSG+BB $_{(0.40)}$ > SG+BB $_{(0.37}$ on fresh weight basis.).

It is more likely recommended that either of the two superior mixtures SG+BRB and PM+BRB were of the best selected combinations regarding Leaf / Stem ratio. Whereas, increasing Leaf / Stem ratio in mixtures increased the nutrition value (TDN and DP) which improved forage quality. Such results may clarify the extra advantages of mixing in turn fodder legumes and grasses, which exerted additional benefits as the obtained increases in enhancing the nutritive value of the relevant mixtures. This is in addition to the fixed nitrogen from the ambient air through the symbiotic soil microflora. The currently presented results of the behaviour of Leaf / Stem ratio of fodder crops and their mixtures were more or less similar those reported by Foster *et al.* (2009) in Fodder cowpea.

Seasonal variations cleared significant difference in Leaf / Stem ratio among the studied Bonavista bean types (Table 5). Results indicated that White type of Bonavista bean was the highest in Leaf / Stem ratio compared to each of other two types (Brown and Black) in the first season. Meanwhile, the Black type was of the highest one in the second season.

In this respect, all of the three tested B.bean types produced relatively slightly higher Leaf / Stem ratio in the second season than the first one. Also, similar trend was noticed for grasses varieties in their Leaf / Stem ratio among the seasonal variations, where the higher Leaf / Stem ratio was noticed during the second season rather than the first one.

Regarding variation of cuts, results in Table (5) proved that Leaf / Stem ratio was generally higher in the second cuts than the first one for all of the tested B. bean types with different magnitudes. On the other hand, all of the three tested varieties of grasses exerted significant higher reduction in Leaf / Stem ratio during the second cuts as compared with the first ones with almost similar magnitudes. Whereas, White B.bean type was the highest Leaf / Stem ratio during the second cut and Sudan grass of the lowest Leaf / Stem ratio during the second cut(Table 5). Also, it is noticed that there was appreciable difference in Leaf / Stem ratio for the first than the later cuts with different behaviour among the grown mixtures.

Table 5: Leaf / Stem ratio of legumes, grasses and their proposed mixtures.

Pure & Mixtures		First summer season (2011)			Second summer season (2012)			Combined (over growing seasons)		
Forages*		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
	on fresh weight basis									
Pure stands	PM	0.69	0.49	0.59	1.16	0.62	0.89	0.93	0.56	0.74
	SG	0.25	0.48	0.36	0.63	0.38	0.50	0.44	0.43	0.43
	SSG	0.41	0.58	0.49	0.61	0.51	0.56	0.51	0.54	0.52
	W B	0.87	1.03	0.95	0.92	1.11	1.01	0.89	1.07	0.98
	B B	0.57	0.81	0.69	0.96	1.15	1.05	0.77	0.98	0.87
	BR B	0.76	0.74	0.75	1.17	0.83	1.00	0.97	0.78	0.87
Relevant mixtures (50 + 50 %)	PM + W B	1.04	0.40	0.72	0.77	0.37	0.57	0.90	0.38	0.64
	PM + B B	0.54	0.46	0.50	0.88	0.29	0.58	0.71	0.37	0.54
	PM + BR B	1.24	0.81	1.02	1.22	0.25	0.73	1.23	0.53	0.88
	SG + W B	0.33	0.55	0.44	0.62	0.32	0.47	0.47	0.43	0.45
	SG + B B	0.12	0.40	0.26	0.33	0.65	0.49	0.23	0.52	0.37
	SG + BR B	0.99	0.30	0.64	1.85	0.69	1.27	1.42	0.49	0.95
	SSG + W B	0.51	0.46	0.48	0.61	0.77	0.69	0.56	0.61	0.58
	SSG + B B	0.43	0.30	0.36	0.64	0.24	0.44	0.54	0.27	0.40
	SSG + BR B	0.94	1.33	1.13	0.28	0.23	0.25	0.61	0.78	0.69
LSD at: 5% for:		F= 0.08	F= 0.09		F= 0.15	F= 0.12		F= 0.08 Y= 0.06 FY= 0.12	F= 0.07 FY= 0.11	

** PM = Pearl millet, SG = Sudan grass, SSG = Sorghum Sudan grass, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean.*

Plant height:

Data for the height of plants in their pure stands were varied according their nature (legumes/ grasses) types and or varieties, as it is clear from the combined analysis (Table 6).

It is also clear from the combined analysis that there were appreciable differences among the grown B.bean types in their plant heights with variable significant magnitudes. Black B.type was of the tallest plants (162.40) followed by Brown B.type (139.35), then White B.type (135.10 cm) with significant differences. Also, the combined analysis showed that, there were appreciable differences among the grown grasses in their plant heights during each of the two growing seasons significantly. Sudan grass was of the tallest plants whereas; Sorghum Sudan grass and Pearl millet produced almost similar plant heights which was 143.95 and 143.60 cm, respectively. The respective descending ranking order for plant height was Sudan grass (167.30), Sorghum

Sudan grass (143.95) and pearl millet (143.60 cm). This trend was clear during each of the two growing seasons of plant height (Table 6).

Combined analysis showed that mixtures heights of the three summer grasses with the three indigenous-native legumes could be ranked in descending order as follow: SSG+BRB$_{(159.50)}$ > SG+WB $_{(149.40)}$ > SSG+BB $_{(146.25)}$ > SG+BB $_{(144.30)}$ > SG+BRB $_{(137.65)}$ > SSG+WB $_{(126.25)}$ > PM+BB $_{(122.85)}$ > PM+BRB $_{(114.85)}$ >PM+WB $_{(111.65\ cm.)}$, with significant differences among the subsequent order. It is more likely recommended that either of the two superior mixtures SSG+BRB and SG +WB were the best combinations in plant height.

The currently presented results of the behaviour of dry forage productivity of fodder crops and their mixtures were more or less similar those reported by Mohamed (1992) for they sorghum with cowpea, Geren *et al.* (2008) for they maize with cowpea and Mohamed *et al.* (2008) for they sorghum with cowpea.

Seasonal variation clarified significant difference in plant height among the indigenous-native legumes (B.bean types). Results show that Black type of Bonavista bean was significantly tallest in the heights compared to each of other two of the types. These results were true in each of the two growing seasons. It is also noticed that all three tested B.bean types produced relatively higher heights of plants in the first season than the second one. Concerning fodder grasses, results in Table (6) exerted that plant height could be ranked in the following descending order: Sudan grass (182.40), then Pearl millet (165.35) followed by Sorghum Sudan grass (157.75 cm)in the first season, being Sudan grass(152.15) then Sorghum Sudan grass (130.15) followed by Pearl millet (121.85 cm) in the second season.

The combined analysis clarified that plant heights was generally higher in the second cuts than the first ones for all of the tested B. bean types and fodder grasses with different significant magnitudes (Table 6). It looks to be true that significant superiority of plant height for the grown grasses varieties than B.bean types for the first than the second season. In this respect, significant differences in plant height for each of the grown grasses was indeed due to their individual specific genetical make up that interact differently with the prevailing environmental conditions of this study in various specific patterns (Table 1). Similar results were reported by Jilani *et al.* (2001) with lablab

It is obviously clear from the combined analysis, Sudan grass was the tallest plants for the first cut and the pearl millet was the shortest one of the second cut for the grasses. Meanwhile, the Black Bonavista bean was the tallest plants as compared the other two B.bean types during each of the two cuts (Table 6).

Table 6: Plant height of legumes, grasses and their proposed mixtures.

Pure & Mixtures	Forages*	First summer season (2011)			Second summer season (2012)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		(Cm)								
Pure stands	PM	219.0	111.7	165.35	108.0	135.7	121.85	163.5	123.7	143.60
	SG	220.0	144.8	182.40	135.3	169.0	152.15	177.7	156.9	167.30
	SSG	204.0	111.5	157.75	117.3	143.0	130.15	160.7	127.2	143.95
	W B	116.6	148.7	132.65	89.3	185.7	137.50	103.0	167.2	135.10
	B B	137.3	198.0	167.65	101.3	213.0	157.15	119.3	205.5	162.40
	BR B	100.6	182.7	141.65	79.7	194.3	137.00	90.2	188.5	139.35
Relevant mixtures (50 + 50 %)	PM + W B	120.3	97.6	108.95	100.7	128.0	114.35	110.5	112.8	111.65
	PM + B B	106.6	101.8	104.20	116.0	167.0	141.50	111.3	134.4	122.85
	PM + BR B	108.6	93.3	100.95	111.3	146.0	128.65	110.0	119.7	114.85
	SG + W B	207.0	139.3	173.15	123.7	127.7	125.70	165.3	133.5	149.40
	SG + B B	145.3	120.4	132.85	132.0	179.3	155.65	138.7	149.9	144.30
	SG + BR B	150.6	120.0	135.30	138.0	142.0	140.00	144.3	131.0	137.65
	SSG + W B	129.3	123.0	126.15	136.0	116.0	126.00	132.7	119.8	126.25
	SSG + B B	172.6	103.0	137.80	154.3	155.0	154.65	163.5	129.0	146.25
	SSG + BR B	174.0	131.0	152.50	134.7	198.3	166.50	154.3	164.7	159.50
LSD at: 5% for:		F= 17.61	F= 14.80		F= 19.09	F= 14.80		F= 12.71 Y= 7.35 FY= 17.97	F= 10.24 Y= 5.27 FY= 14.48	

** PM = Pearl millet, SG = Sudan grass, SSG = Sorghum Sudan grass, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean.*

Crude protein (CP) content:

Data in Table (7) showed no appreciable differences in CP content within each of the three Bonavista bean types or between any of the three summer grasses varieties in their pure stands. On other words, CP contents were more or less similar for the three B.bean types and within the three summer grass varieties as well.

Combined analysis showed that any of the grown B.bean types exerted relatively higher CP content than any of the grown summer fodder grasses varieties in their pure stands. In this respect, there were significant differences among the grown B.bean types in their CP contents. Brown B.bean type was of highest CP content

(23.44), followed by Black B.bean type (22.73), then White B.bean type (19.14%), respectively. On the other hand, the summer fodder grasses did not exerted appreciable significant differences in between. Whereas; the respective descending ranking order was of Sudan grass (10.55), Pearl millet (10.15) and Sorghum Sudan grass (9.59%), respectively.

Combined analysis exerted that mixtures CP content of the three summer grasses with the three indigenous-native legumes could be ranked in descending order as follow: SSG+WB $_{(12.72)}$ > SSG+BB $_{(12.70)}$ > PM+BRB $_{(12.57)}$ > SG+WB $_{(11.94)}$ > SG+BB $_{(11.92)}$ > PM+BB $_{(11.83)}$ > PM+WB $_{(11.80)}$ > SG+BRB $_{(11.40)}$ > SSG+BRB $_{(11.30\ \%)}$, with significant differences among the subsequent order. It is more likely recommended that either of the two superior mixtures SSG+WB and SG +BB were the best combinations in CP content.

Similar results were reported by Mohanpillai *et al.* (1990) for mixed maize with cowpea, Abd El Aal *et al.* (1991) for mixed Sordan with guar, Sood and Sharma (1992) for mixed sorghum with cowpea, Sudhaker *et al.* (1996) for mixed grasses with legumes, Abd El-Salam (2002) for pearl millet and Sudan grass with legumes, Zeidan *et al.* (2003) for Fodder maize with cowpea and Geren *et al.* (2008) for mixed maize with cowpea.

It should be also noted from Table (7) that CP content decreased clearly as the stage of growth proceeded from the first to the second cut. These results were obtained for either B.bean types or summer fodder grasses in their pure stands during the two seasons.

Seasonal variations were observed between the tested forages where CP content of B.bean types could be ranked in the following descending order: Black B.bean type (23.85), then Brown B.bean type (23.71) followed by White B.bean type (17.03%) in the first season, being Brown B.bean type (23.18), then Black B.bean type (21.62) followed by White B.bean type (21.25%) in the second season. Meanwhile, the respective descending ranking order of grasses varieties was Sudan grass (10.51), then Pearl millet (9.48) followed by Sorghum Sudan grass (9.43%) in the first season, being Pearl millet (10.84) then Sudan grass (10.59) followed by Sorghum Sudan grass (9.75%) in the second season.

Table 7: Crude protein (CP) content of legumes, grasses and their proposed mixtures.

Pure & Mixtures Forages*		First summer season (2011)			Second summer season (2012)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		……(%.)……								
Pure stands	PM	9.61	9.35	9.48	10.96	10.72	10.84	10.28	10.03	10.15
	SG	10.58	10.45	10.51	10.91	10.28	10.59	10.74	10.36	10.55
	SSG	9.94	8.93	9.43	10.12	9.38	9.75	10.03	9.16	9.59
	W B	18.67	15.39	17.03	22.81	19.69	21.25	20.74	17.54	19.14
	B B	24.33	23.37	23.85	21.93	21.31	21.62	23.13	22.34	22.73
	BR B	24.04	23.39	23.71	25.51	20.85	23.18	24.77	22.12	23.44
Relevant mixtures (50 + 50 %)	PM + W B	12.12	12.13	12.12	12.54	10.43	11.48	12.33	11.28	11.80
	PM + B B	10.31	10.54	10.42	13.67	12.79	13.23	11.99	11.67	11.83
	PM + BR B	12.34	11.90	12.12	13.17	12.86	13.01	12.76	12.38	12.57
	SG + W B	12.94	12.53	12.73	10.49	11.81	11.15	11.71	12.17	11.94
	SG + B B	12.53	12.46	12.49	10.69	12.02	11.35	11.61	12.24	11.92
	SG + BR B	13.05	10.72	11.88	10.56	11.29	10.92	11.81	11.00	11.40
	SSG + W B	13.06	11.21	12.13	14.00	12.62	13.31	13.53	11.92	12.72
	SSG + B B	12.40	12.33	12.36	13.27	12.80	13.03	12.83	12.57	12.70
	SSG + BR B	11.04	9.98	10.51	12.31	11.86	12.08	11.68	10.92	11.30
LSD at: 5% for:		F= 1.09	F= 0.63		F= 1.02	F= 1.06		F= 0.73 FY= 1.03	F= 0.60 FY= 0.85	

** PM = Pearl millet, SG = Sudan grass, SSG = Sorghum Sudan grass, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean.*

Regarding the subsequent cuts, combined analysis show that CP content was higher in the first cuts than the second ones for all of the six tested forages with various slight ignorable significant magnitudes (Table 7). It should be pointed out that the obtained significant differences in CP content for each of the grown grasses and legumes were indeed due to their individual specific genetical make up that interact differently with the prevailing environmental conditions of this study in various specific patterns (Table 1). These results are in general agreement with those reported by several investigators as Mokoboki *et al.* (2000) whome they cowpea, Jilani *et al.*(2001) whome they lablab and Odunsi (2003) whome they lablab.

It is also clear from the combined analysis, Brown B. bean type was the highest CP content for the first cut and the White type was the lowest one of the second cut for the B. bean types. Meanwhile, Sudan grass was the highest CP content for the first cut and Sorghum Sudan grass the lowest one of the second cut for grasses (Table 7).

Crude fiber (CF) content:

Results in Table (8) did not show noticeable or significant differences in crude fiber (CF) contents between either the 3-grown Bonavista bean types (White, Black and Brown types) or the 3-grown fodder grasses

varieties (pearl millet, Sudan grass and Sorghum Sudan grass). It could be understood that such trait is similar in their genetical makeup and/or gene expression in CF content.

Table 8: Crude fiber (CF) content of legumes, grasses and their proposed mixtures.

Pure & Mixtures	Forages*	First summer season (2011)			Second summer season (2012)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		……(%.)……								
Pure stands	PM	29.95	31.80	30.87	28.77	31.45	30.11	29.36	31.63	30.49
	SG	27.86	31.80	29.83	29.44	31.04	30.24	28.65	31.42	30.03
	SSG	26.00	34.15	30.07	29.83	30.63	30.23	27.92	32.39	30.15
	W B	30.69	32.49	31.59	29.20	31.76	30.48	29.95	32.12	31.03
	B B	26.12	32.77	29.44	29.55	31.01	30.28	27.83	31.89	29.86
	BR B	28.24	29.66	28.95	29.92	32.35	31.13	29.08	31.00	30.04
Relevant mixtures (50 + 50 %)	PM + W B	32.01	33.08	32.54	29.00	30.85	29.92	30.51	31.97	31.24
	PM + B B	28.84	30.37	29.60	30.13	34.18	32.15	29.49	32.28	30.88
	PM + BR B	28.17	32.42	30.29	30.20	32.88	31.54	29.19	32.65	30.92
	SG + W B	31.20	30.29	30.74	29.51	33.06	31.28	30.36	31.67	31.01
	SG + B B	29.53	32.04	30.78	30.63	33.32	31.97	30.08	32.68	31.38
	SG + BR B	29.84	32.89	31.36	28.64	31.55	30.09	29.24	32.22	30.73
	SSG + W B	28.25	32.08	30.16	30.84	33.30	32.07	29.55	32.69	31.12
	SSG + B B	27.98	31.06	29.52	29.55	32.80	31.17	28.77	31.93	30.35
	SSG + BR B	29.63	31.66	30.64	31.29	32.14	31.71	30.46	31.90	31.18
LSD at: 5% for:		F= 1.60	F= 1.34		F= 0.89	F= 1.56		F= 0.90 Y= 0.31 FY= 1.27	FY= 1.42	

** PM = Pearl millet, SG = Sudan grass, SSG = Sorghum Sudan grass, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean.*

Combined analysis showed there were no significant differences among the grown B.bean types in their CF contents. White B.bean type was of highest CF content (31.03), followed by Brown B.bean type (30.04), then Black B.bean type (29.86%), respectively. On the other hand, the summer fodder grasses did not exerted appreciable significant differences in between. Whereas; the respective descending ranking order was of Pearl millet (30.49), Sorghum Sudan grass (30.15) and Sudan grass (30.03%), respectively. This trend was more or less ignorable magnitudes during the two growing seasons of CF content as it is clear in Table (8).

It is obviously clear that, CF content of B.bean types could be ranked in the following descending order: White B.bean type (31.59), then Black B.bean type (29.44) followed by Brown B.bean type (28.95%) in the first season, being Brown B.bean type (31.13), then White B.bean type (30.48) followed by Black B.bean type(30.28%) in the second season. Meanwhile, the respective descending ranking order of grasses varieties was Pearl millet (30.87), then Sorghum Sudan grass (30.07) followed by Sudan grass (29.83%) in the first season, being Sudan grass (30.24) then Sorghum Sudan grass (30.23) followed by Pearl millet (30.11%) in the second season.

Concerning the mixtures CF content of the three summer grasses with the three indigenous-native legumes, results of the combined analysis could be ranked in descending order as follow: SG+BB (31.38) > PM+WB (31.24) > SSG+BRB (31.18) > SSG+WB (31.12) > SG+WB (31.01) >PM+BRB (30.92) > PM+BB (30.88) > SG+BRB (30.73) >SSG+BB (30.35 %), without appreciable significant differences among the subsequent order. It is more likely recommended that either of the two mixtures SG+BB and PM+WB were the best combinations in CP content. Similar results were reported by Mohamed (1992) for sorghum with cowpea, Abd El-Salam (2002) for pearl millet and Sudan grass with legumes and Ibrahim *et al.*(2006) for maize with cowpea.

Seasonal variations were noticed between the tested forages where CF content of B.bean types could be ranked in the following descending order: White B.bean type (31.59), then Black B.bean type (29.44) followed by Brown B.bean type (28.95%) in the first season, being Brown B.bean type (31.13), then White B.bean type (30.48) followed by Black B.bean type (30.28%) in the second season. Meanwhile, the respective descending ranking order of grasses varieties was Pearl millet (30.87), then Sorghum Sudan grass (30.07) followed by Sudan grass (29.83%) in the first season, being Sudan grass (30.24) then Sorghum Sudan grass (30.23) followed by Pearl millet (30.11%) in the second season.

Regarding the subsequent cuts, combined analysis show that CF content was higher in the second cuts than the first ones for all of the six tested forages with various slight ignorable significant magnitudes (Table 7). It looks to be true that from Table (8) that CF content increased clearly as the stage of growth proceeded from the first to the second cut. These results were obtained for either B.bean types or summer fodder grasses in their pure stands during the two seasons.

It is also clear from the combined analysis, White B. bean type was the highest CF content for the first cut and the Brown type was the lowest one of the second cut for the B. bean types. Meanwhile, Pearl millet was the highest CF content for the first cut and Sudan grass was of the lowest one in the second cut for grasses (Table 8). Similar results were reported by Odunsi (2003) for they lablab and Foster *et al.* (2009) for soybean and cowpea.

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