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Impact of planting dates on yield and pod quality traits of snap bean under short-temperate season climates

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Summary: Snap bean, a warm-season crop, have low frost tolerance. The optimal temperature for seed emergence and plant growth is important. Therefore, appropriate planting dates for adapted varieties has paramount significance in improving pod yield and quality of snap bean under short cool season climates. Three snap bean cultivars planted at 3 different dates were examined to evaluate the effects of planting dates on snap bean pod yield and quality traits in a 2-year study in a short season climate in Manitoba, Canada. Results of this study showed that three, two weeks apart, planting dates had a non- significant effect on marketing yield of three different cultivars tested in this study. Planting dates showed significant effect on un-marketable yield, pod fresh weight, pod length and total soluble solids. Higher marketable and un-marketable yields along with longer pod length and soluble solids, in all three cultivars, were more profound when seeded at mid and late planting dates. Snap bean grew under higher temperature and accumulated more growing degree days (GDD) when planted in mid June and early July when compared to early June planting. These results conclude that marketable yields of snap bean were not significantly affected by planting dates when seeded-two weeks apart-in shorter growing environments which allow commercial and market gardeners, in northern areas with shorter growing seasons to optimise planting snap bean, without reducing pod yield and quality.

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Key words: *Phaseolus vulgaris* L., marketable yields, un-marketable yields, temperatures, northern climate

Introduction

Legumes are an important component in the diets of humans and are consumed as dried or green beans. The legume crops grown for human consumption belong to the family Fabaceae, formerly known as Leguminosae. The most commonly grown species are the common bean (*Phaseolus vulgaris* L.) and black-eyed peas (*Vigna unguiculata* L. Walp.). The common bean (*Phaseolus vulgaris* L) is also considered one of the richest sources of protein (Baudoin & Maquet, 1999), vitamins and dietary fiber (Kelly & Scott, 1992), and are known as snap bean, green beans, French beans or string beans which are widely used as a vegetable, when harvested as immature pods, and is considered an important food source in many parts of the world (Richardson, 2012). Common beans are cultivated throughout the world and its production spans from 52°N to 32°S latitude (Schoonhoven & Voysest, 1991) under a wide range of environmental conditions. Common beans are also known as nitrogen fixing crops, with the ability to fix soil nitrogen, therefore minimizing nitrogen fertilizer inputs (Piha & Munns, 1987) and improving soil conditions (Nason & Myrold, 1992). By serving as an alternate to inorganic nitrogen fertilizers, beans simultaneously help minimize the adverse effect of the excessive use of chemicals on the environment.

World vegetables production grew faster between 2000 and 2019, as it went up 65 percent, 446 million tonnes to 1128 million tonnes in 2019 (FAO, 2019). A total of 2,847,976 metric tonne of marketable vegetable produced in Canada, of which 76% (2,183,527 metric tonne) is from field vegetables (Statistic Canada, 2020). Worldwide 23.27 million metric tonnes of snap bean are produced in 2020. In Canada, amongst the field vegetable crops, snap bean ranked 3rd in planted area (8,479 of total 102,022 hectares) with 59,892 MT of marketed production, and farm gate value of $38,279,000 CDN, accounting for 2% of total $1,294,903,000 CDN farm gate value. Although, cereal and oil seed crop production dominate in Manitoba, vegetables crop contribute $32,588,000 CDN farm gate value to the overall Canadian economy (Statistic Canada 2020). Approximately 31,820 MT of snap bean were imported as fresh beans for edible consumption in 2018, which is ~7.5% increase from the 2019-year import of 29,550 metric tons (Statistic Canada 2019). In Manitoba, snap bean is not produced in large acreages, with only 146 acres producing 94 tonnes of marketable snap bean reported in 2018 and approximately 150 estimated acres of snap bean in 2019 (Statistic Canada 2019). The Manitoba region has a shorter and a colder temperature climate having a frost-free period of 75 to 125-135 days. These shorter frost-free periods are a major restrictive factor for commercial production of many field vegetables in this region (Manitoba Agriculture 2020). However, in Manitoba, cool-season vegetables and some warm season crops with shorter maturity can be grown and harvested as green vegetables. Even with the shorter growing season, Manitoba ranked 6th in field vegetable planted area, (1,506 hectares), producing 20,515 metric tons of marketable field vegetables (Statistic Canada 2020).

These snap beans, when grown to harvest immature pod when young and tender, take 60-70 days from seed to harvest and can be grown in cropping systems like Manitoba, either as part of crop diversification or market gardening. Soil temperature ranging from 16 ºC to 29 ºC is required for the optimum growth of snap bean; seeding below 10 ºC will affect germination, and seed may simply deteriorate in the soil (Nonnecke, 1989). Planting of beans in a shorter growing region may affect plant growth and pod characteristics of beans and this has been the focus of studies in many in different regions of the world. Marlene et al. (2008) reported that beans are more sensitive to environmental stress affecting yield, growth and pod traits as compared to other field vegetables. Frequency of high and low temperatures, water deficit periods and extended precipitation due to the climatic changes limits the production of vegetables in open field conditions (Abd Al-Shammari et al., 2020; Nemeskéri et al., 2015; Molnár et al., 2015). A significant difference was reported (Nemeskéri et al., 2018) in stomatal density on both leaf surfaces between the green-podded and yellow-podded snap bean varieties, during flowering and pod development, under water deficiency and concluded that under non-irrigated conditions, stomatal resistance measured during flowering had a large effect on the individual pod yield. Orsi et al. (2021) reported variable flower and pod abscission dynamics in different gene pools and genotypes of common beans. Vega, Chapman & Hall (2001), reported that changes to the management of planting season or cultivar always resulted in corresponding changes in pod and seed number.

Previous studies carried out on snap bean planting season and or plating dates demonstrate a predominant influence on yields and yield related traits when evaluated in different growing regions. This factor has not been fully explored for snap bean production in shorter frost-free period growing seasons. Hence, determining optimum planting dates for snap bean in a short growing environment is valuable for producers in these regions to diversify crop production. In this study, the effect of planting season on snap bean cultivars was examined in conditions representative of Canadian prairie growing areas. Marketable yield per plant can make the difference between being profitable or not for these growers. The objectives of this snap bean experiment are to: 1) study the effect of different planting dates on yield and pod quality traits of snap bean; 2) identify the optimum planting dates for snap bean under Manitoba growing conditions. The results of this project can positively impact commercial and market garden producers by making snap bean a profitable horticultural crop.

Materials and methods

Experimental site and plant material

The experiment took place in 2016 and 2017 at the Assiniboine Community College (ACC) Horticultural Grow Plot, Brandon, Manitoba, Canada (49ºN, 99ºW). The average frost-free period in this region is 105-115 days. Average annual accumulated GDD for the Brandon region, range from 950-1050 and 450-550 at base temperatures of 10 ºC and 15 ºC respectively (Manitoba Agriculture 2020). The average minimum and maximum temperatures, rainfall and growing degree days (GDD) for the experimental location and months are displayed in ***Table 1***. Three locally grown snap bean cultivars, "Purple Royalty" (PR), "Tender Green" (TG) and Gold Rush" (GR) were chosen to represent a range of snap bean varieties available to the fresh market. The snap bean cultivars were seeded as early planting (late May), mid planting (mid-June) and late planting (early July) in each of 2016 and 2017 (***Table 2***). Local commercial seed company provided the snap bean seeds used in this project.

Planting and fertilizer application

The experimental trial was a randomized complete block design with four replications. For both years of the study, the 422 m^2 experimental area was prepared followed growers' standard cultivation practices to loosen and pulverize the soil for seeding. Plots were 2.4 m wide and 3-m in length, with 4 rows spaced 60 cm and 20 cm between hills, for each cultivar within each replication and planting date. The middle two rows were harvested for data evaluation and outside two rows were guard rows. Two seeds per hill were hand-planted in each row and thinned a week after germination to maintain uniform plant population. Plots were irrigated as required to minimize moisture stress and commercial fertilizer applied through drip irrigation tape-row crop dripper line–0.95 l h^{-1} (Irritec, Fresno, CA. USA Inc.) for plant optimum growth in both experimental years. Plants were irrigated 3 hour per day, twice a week in spring whereas in summer months, plants were irrigated three times a week using an irrigation timer and adjusting for previous week received rainfall Each plot received 200 ppm of nitrogen from a commercial soluble fertilizer blend of 18-9-18 was applied in four applications (181 g per application) with injector ratio 1:100 using Dosatron (D125-Dosatron International, Inc., Clearwater, FL USA) for a total of 725 g of Nitrogen/93 m^2/season. Disease and pests were controlled as per usual growing conditions and weed control was carried manually as required.

Yield and yield components evaluation

Cultivars Tender Green, Gold Rush and Purple Royalty pods were harvested before reaching maturity, 2-3 weeks after blooming, when pods were fleshy, tender and attained green, gold, and purple color respectively for Pod harvesting started 60 days after planting and continued, with multiple harvesting, for three weeks. At harvest, for each cultivar, all pods suitable for commercial marketing were weighted as marketable (disease free and regularly shaped) whereas, pods, which are malformed, broken, overgrown, with symptoms of pest and disease damage were weighed as unmarketable yields. Total yields were calculated as the sum of marketable and unmarketable pods. Pod fresh weight and length were measured on 20 random fresh marketable pods per plot. Pod width measured using HM. Clause raw product gauge, rated 1-5, (1=5.75 mm, 2=7.34 mm, 3=8.33 mm, 4=9.52 mm and 5=10.71 mm) for USA Beans. Measurements from each harvest were averaged over the season. Total soluble solid were determined when the pods were crushed, and the refractive index on the expressed juice was measured using an Atago PAL 3 (Atago USA Inc. Bellevue, WA USA) digital refractometer (ranging 0-93%).

Climate Data Acquisition and Data Analysis

Climatic conditions were recorded using Argus Titan system version 718 (Argus, 2014) and from the Brandon Meteorological Station (ID: CA005010490). A Titan WS2 weather station was

Table 1. Temperatures, total rainfall and growing degree-days for the growing season in Brandon during 2016 and 2017.

Month	2016					2017				
	Temperature °C			Total rainfall (mm)	[x]Growing Degree Days (GDD)	Temperature °C			Total rainfall (mm)	Growing Degree Days (GDD)
	Max	Min	*Avg			Max	Min	*Avg		
May	17.7	4.4	11.0	75.7	87	18.1	2.4	10.3	44.8	71.3
June	20.9	10.7	15.9	211.2	171.6	24.2	10.3	17.3	34.3	200.0
July	24.5	12.4	18.4	13.9	261.7	26.3	13.1	19.7	51.8	302.2
August	24.5	12.1	18.3	53.8	258.5	25.6	10.6	18.1	51.4	252.3
September	19.1	6.3	12.8	37.7	104	21.2	7.1	14.1	32.9	135.2
Avg/total	21.3	9.2	15.3	392.3	882.8	23.1	8.7	15.9	215.2	961

* = Month average; Min= Minimum; Max= maximum; Avg= Average; [x]=Base 10 °C

Table 2*.* Planting dates, temperatures, total rainfall and growing degree days (GDD) accumulated from planting of snap beans until last harvest dates.

Year	Planting Season	Planting date	[y]Last Harvest date	Temperature °C			Total rainfall (mm)	[x]Growing Degree Days (GDD)	
				Max	Min	*Avg		Cumulative GDD	Difference in GDD from previous harvest
2016	Early	27-May	09-Aug	23.8	11.9	19.9	257.8	563	NA
	Mid	15-Jun	28-Aug	23.7	12.1	17.9	277.3	567	4
	Late	04-Jul	16-Sep	23.0	10.6	16.9	93.7	546	-21
2017	Early	27-May	08-Aug	25.1	11.2	18.2	99.9	597	NA
	Mid	16-Jun	28-Aug	25.9	11.8	18.9	113.0	694	97
	Late	01-Jul	16-Sep	25.0	10.9	18.0	135.1	625	-69

*=Season average; Min= Minimum; Max= maximum; Avg= Average; [a]=Base 10 °C

[y]=Harvest started after 60 day of planting and continued for three weeks

Table 3*.* F ratios and effect of planting dates on yields and pod quality characteristics of snap bean cultivars evaluated during 2016 and 2017 (2 years Average).

	Marketable yield (Kg acre^{-1})	Un-marketable yield (Kg acre^{-1})	Pod fresh weight (g)	Pod length (cm)	Pod width (1-5)	Soluble solids °Brix
Planting Dates	Means					
Early	4348[a]	871[b]	0.172[b]	13.03[b]	3.90[a]	4.66[b]
Mid	5010[a]	1417[a]	0.188[a]	12.43[b]	3.84[a]	4.89[a]
Late	5022[a]	1424[a]	0.169[b]	13.90[a]	3.86[a]	5.01[a]
LSD	749	261	0.0156	0.613	0.168	0.149
Source of Variation	Significance					
Year	*	***	***	***	***	***
Variety	**	NS	***	NS	***	NS
Planting Date	NS	***	*	***	NS	***
Year x Variety	NS	NS	NS	NS	*	NS
Year x Planting Date	NS	**	NS	NS	**	***
Variety x Planting Date	NS	NS	NS	NS	NS	NS
Year x Variety x Planting Date	NS	NS	NS	NS	NS	NS
CV	23.1	31.2	13.1	6.9	6.4	4.5

*, **, *** represents P=0.05, 0.01, 0.001 respectively and ns, not significant

[a-b]=means within a column followed by the same letter are not significantly different at P<0.05 according to LSD.

Table 4. Main effects (by year and cultivar) of planting dates on yields, pod characteristics of snap bean cultivars.

Year/ Planting	Marketable yield (Kg acre^{-1})			Un-marketable yield (Kg acre^{-1})			Pod fresh weight (g)			Pod length (cm)			Pod width (1-5)			Soluble solids °Brix		
	PR[1]	T	GR	PR	T	GR	PR	T	GR	PR	T	GR	PR	T	GR	PR	T	GR
2016									**Significance**									
	0.70^{ns}	0.61^{ns}	0.35^{ns}	0.33^{ns}	0.20^{ns}	0.01*	0.06*	0.97^{ns}	0.33^{ns}	0.53^{ns}	0.14^{ns}	0.01*	0.55^{ns}	0.07^{ns}	0.88^{ns}	0.63^{ns}	0.323^{ns}	0.11*
									Means									
Early	3702^{a}	4689^{a}	4791^{a}	815^{a}	818^{a}	761^{b}	0.14^{b}	0.13^{a}	0.19^{a}	14.3^{a}	13.3^{a}	12.6^{b}	3.5^{a}	4.4^{a}	3.2^{a}	4.8^{a}	4.7^{a}	4.4^{b}
Mid	3354^{a}	5461^{a}	4211^{a}	1034^{a}	865^{a}	953^{b}	0.18^{a}	0.13^{a}	0.18^{a}	13.7^{a}	13.5^{a}	12.7^{b}	3.5^{a}	4.3^{a}	3.2^{a}	4.7^{a}	4.6^{a}	4.7^{a}
Late	3459^{a}	4572^{a}	5267^{a}	863^{a}	1328^{a}	1630^{a}	0.15^{ab}	0.13^{a}	0.15^{a}	14.4^{a}	14.4^{a}	14.1^{a}	3.2^{a}	4.0^{a}	3.16^{a}	4.6^{a}	4.5^{a}	4.5^{ab}
LSD	1019	2317	1651	350	677	513	0.028	0.049	0.058	1.52	1.22	0.89	0.73	0.41	0.38	0.57	0.34	0.32
2017									**Significance**									
	0.25^{ns}	0.200^{ns}	0.26^{ns}	0.21^{ns}	0.15^{ns}	0.01*	0.06*	0.88^{ns}	0.62*	0.14*	0.20^{ns}	0.29^{ns}	0.75^{ns}	0.14^{ns}	0.406^{ns}	0.01**	0.01**	0.01*
									Means									
Early	3738^{a}	4900^{a}	4269^{a}	1361^{a}	850^{a}	617^{b}	0.19^{ab}	0.17^{a}	0.18^{b}	12.1^{b}	12.6^{a}	13.1^{a}	4.1^{a}	4.4^{a}	3.5^{a}	4.5^{b}	4.6^{b}	4.7^{b}
Mid	5259^{a}	7493^{a}	4282^{a}	2006^{a}	1976^{a}	1666^{a}	0.20^{a}	0.18^{a}	0.24^{a}	11.9^{b}	11.0^{a}	11.6^{a}	4.1^{a}	4.2^{a}	3.5^{a}	4.9^{b}	5.1^{a}	5.1^{b}
Late	4949^{a}	5991^{a}	5894^{a}	1459^{a}	1650^{a}	1608^{a}	0.17^{b}	0.17^{a}	0.22^{ab}	14.4^{a}	13.3^{a}	12.6^{a}	4.2^{a}	4.7^{a}	3.7^{a}	5.5^{a}	5.1^{a}	5.6^{a}
LSD	2101	3087	2518	856	1243	667	0.026	0.057	0.045	1.61	2.81	2.12	0.44	0.48	0.42	0.42	0.32	0.56

$^{a-b}$=means within a column followed by the same letter are not significantly different at $P<0.05$ according to LSD.

*, **, *** represents P=0.05, 0.01, 0.001 respectively and ns, not significant. [1]Cultivars are ‘Purple Royalty’ (PR), ‘Tendergreen’ (T) and ‘Gold Rush’ (GR)

configured with the Argus Titan Control System to record on-site weather information for outdoor temperature (°C), light energy (W/m^2), wind speed and wind direction. The experiments were a randomized complete block design with four replications. Data were subjected to analyses of variance (ANOVA) using CoStat ver. 6.45 (Cohort Software Birmingham, U.K). Differences between treatment means were determined using Fisher's least significant difference at α = 5%.

Results

Air temperature during the growing seasons averaged between 15.3 °C (2016) and 15.9 °C (2017) (***Table 1***). For early, mid and late planting dates, air temperatures averaged 19.9 °C, 17.9 °C and 16.9 °C respectively in year 2016, whereas in 2017 air temperature were 18.2 °C, 18.9 °C, and 18.0 °C for early, mid and late planting dates respectively (***Table 2***). More rain was received in early (257.8 mm) and mid (277.3 mm) plantings in year 2016 compared to early (99.9 mm) and mid (113 mm) planting in 2017. The late planted crop received higher precipitation in 2017 when compared to the early and mid planted crop. Higher rainfall was recorded in the mid and early planted crops compared to late planting in 2016, whereas year 2017 received more rainfall in early and mid planting compared to late planting (***Table 2***). The beans crop received more GDD in 2017 growing season compared to year 2016, with respect to each planting dates. Crop accumulated more GDD in early and mid planting, 563 & 567 in 2016 and 597 & 694 in 2017, compared to late planting, 546 & 625, in year 2016 and 2017 respectively.

Data from the two years was combined and was analysed to determine the impact of different planting dates, cultivar and interactions on bean yields and pod quality traits (***Table 3***). Significant differences for the yields and pod quality traits were recorded for between years comparisons, whereas varieties showed only significant differences for marketable yield, pod fresh weight and pod width. Different plantings did not show any noticeable difference in marketable yield and pod width, however, beans planted on different dates showed significant differences for other yield and quality traits examined in this project. Interaction between year x variety x planting dates was recorded as non-significant for the yield and pod quality traits. Similarly, variety x planting dates interaction was non-significant for the yields and pod quality traits, suggesting variety selection did not affect yield and yield related traits when planted at different dates. However, year x sowing date interaction presented noticeable differences in total soluble solids, pod width and un-marketable yields. Early, mid and late plantings had no effect on marketable yields and pod width of any cultivar tested in year 2016 and 2017 (***Table 3-4***). In 2016, different planting dates affected un-marketable yields, pod length and soluble solids of cultivar 'Gold Rush' but not those of 'Purple Royalty' and 'Tender Green'. Whereas, in 2017 un-marketable yields, pod fresh weight and soluble solids were significantly different with different plantings of 'Gold Rush' cultivar, and there was no effect of planting dates on pod width. (***Table 4***). In 2016, Pod fresh weight differed significantly for 'Purple Royalty' cultivar when planted on different dates, but not those of 'Tender Green' and 'Gold Rush'. Pod fresh weight did not show significant difference for 'Purple Royalty' cultivar for any of the described seeding dates in 2017.

All three cultivars soluble solids were affected significantly for pod production in year 2017 when seeded in early, mid and late plantings. Whereas in 2016 only 'Gold Rush' cultivar showed significant difference in soluble solids when planted at different dates (***Table 4***). Pod length showed significant differences with respect to planting dates for 'Purple Royalty' in 2017, whereas, in 2016 no difference was found for pod length for 'Purple Royalty' planted in different dates. In general, the effect of planting dates for yield and pod traits varied with year and cultivar.

Discussions

Temperature requirements for a bean crop varies during various stages of its life cycle with varying base temperature needed for growth at each developmental stage. Kish & Ogle (1980) and Mullins & Straw (1999) referenced 10 °C as the common used base temperature to estimate the GDD at each developmental growth stage of beans. In this study, the minimum temperatures during early, mid and late planting ranged from 10.6 °C to 12.1 °C (***Table 2***), which is above 10.0 °C where germination and blossoming may be affected (Dickson & Boettger, 1984) and could result in unmarketable pods. Since the minimum temperature during production stages of beans remained above 10 °C, it did not significantly affect yields in planting dates in both experimental years (***Table 2***). Total rainfall of 392.3 mm starting May through September in 2016 was higher compared to 215.2 mm in 2017. This difference was notable in the month of June with 211.2 mm, in 2016, compared to 34.3 mm rainfall in 2017. However, an even distribution of rainfall was observed in 2017 cropping year compared to 2016, where the month of June received significantly more precipitation than other months of growing season in the same year (***Table 1-2***). The cumulative GDD were higher in 2017, at each early, mid and late planting, compared to 2016. This may be due to high temperature increasing GDD as reported by Ken et al. (2012).

The results of this study revealed significant variations in yields and pod quality traits between each year's evaluation for each cultivar tested. Marketable yield, pod fresh weight and pod width differ significantly for cultivars (***Table 3-4***), whereas, un-marketable yield, pod fresh weight, pod length, and total soluble solids were found be to significantly different for three planting dates in 2 years combined performance (***Table 3***). No difference in yields of any planting date were observed for the cultivars in year 2016. In 2017 mid and late plantings yielded higher marketable and un-marketable pods. Overs the two years of the study, average yields, marketable and un-marketable yields were recorded higher in mid and late planting than in the early planting (***Table 3***). However, no yields were higher from one planting date over another, for cultivars tested in each individual year. Cultivars "Gold Rush and Purple Royalty" produced higher marketable pods in the early planting compared to mid and late plantings in year 2016, whereas in 2017 all three cultivars yielded higher marketable pods in mid and late planting when compared with early planting. This lower yield in year 2017, could be attributed to lower accumulated GDD when seeded as an early season crop when compared to mid and late plantings. Similar results of high bean yield from late planting compared to early planting were recorded by Jamil et al. (2017) while studying the optimal planting dates for French beans. Although marketable and un-marketable yields were not consistent among the cultivars tested (***Table 4***), over 2 years cultivar yield demonstrates higher yield in mid and late plantings. Since each cultivar was testing using the equal number of days from seeding to final harvest, the yield variations for different planting dates between cultivars could be attributed to cultivar characteristics. This is more evident with cultivar 'Purple Royalty' which significantly differs in un-marketable yields in 2016 and 2017. Orsi et al. (2021) found variable flower and pod abscission dynamics in different gene pools and genotypes of common beans and recorded certain bean characteristic to be highly significant in their studies, such as the amount of days to begin flowering, the flowering period, percentage of aborted pods and number of harvested pods. This study did not show a consistent positive relationship between yields and pod quality with respect to different planting dates. Therefore, there is no consistent trend of having higher yields corresponding to pod width, length, fresh weight and soluble solids with respect to planting dates evaluated in this 2-year study.

No consist significance was observed for any planting date over another in pod fresh weight, length, width and soluble solids evaluated for all cultivars when planted early, mid and in late in 2016 and 2017. Longer pod length was recorded in late plantings for all three cultivars in 2016, whereas this trend was only observed for 'Purple Royalty' and 'Tender Green' cultivars in 2017. Bean pod width varied in different planting dates in 2016 compared to 2017 where late planting showed a larger pod width in late planting when compared to early and mid planting. A similar trend of greater soluble solid was recorded in 2017 late planting for all three cultivars, whereas this was not evident in 2016. Comparing the pod and seed characters with yields, Kimeu (2019) observed similar coherence between bean pod characters. In general, all three cultivars studied here to evaluate, yield and pod characteristics, in early, mid and late planting dates, did not appeared to have higher yields and pod quality attributes over any planting date in any production year. These results are consisting with Sparks et al. (2018) study in which no significant differences in yield were observed for the two planting dates of snap bean. However, other studies including Getachew et al. (2014, 2015) reported different planting dates did have a significant influence on yield of green beans.

Conclusions

The results from this study show marketable yields of snap bean were not significantly affected by planting dates when seeded-two weeks apart-in shorter growing environments. However, planting dates influenced pod fresh weight, pod length and soluble solids, which suggests that seeding snap bean from mid to late June could produce better quality pods. Further research exploiting earlier planting dates is recommended to determine the earliest planting growers should use to plant snap beans in their region. Canadian Prairies growers and similar climatic areas can use these findings for growing snap bean with better yield and quality.

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