PRODUCTION CAPABILITY OF CATCH CROPS IN DRY CONDITIONS

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Fresh and dry matter of catch crops was evaluated in maize growing region on clay loamy fluvisol in the years 2009 - 2014. The field experiment was conducted at the field experiment in Žabčice (South Moravia, Czech Republic) which is one of the warmest and driest regions in the Czech Republic. The experiment included ten kinds of catch crops: Sinapis alba, Raphanus sativus v. oleifera, Phacelia tanacetifolia, Fagopyrum esculentum, Secale cereale v. multicaule, Panicum miliaceum, Crambe abyssinica, Malva verticillata, Phalaris canariensis, Carthamus tinctorius. Catch crops stands were established after harvest of winter wheat (August). Growth of catch crops was limited by water and temperature. Sinapis alba, Raphanus sativus v. oleifera, Phacelia tanacetifolia and Crambe abyssinica reached regularly the highest yields of biomass in the observed years. Yield assurance was recorded only for these crops in dry year. The family Brassicaceae and Phacelia tanacetifolia were suitable in term yield certainty and thus achieving the aims of growing catch crops in the place which is one of the warmest and driest regions in the Czech Republic even in a dry year.

Keywords: catch crops, yield, dry conditions

INTRODUCTION

Temperature and precipitation conditions are influenced due to running changes of climatic conditions. This leads to an increasing frequency of extreme situations such as drought and periods of high air temperatures. Extreme weather affects the productivity of field crops (Ramstorf and Coumou, 2011; Gbegbelegbe et al., 2014). Climate change is likely to add to worsening existing problems e.g. soil degradation through erosion, in the area of unwanted pests and weeds (Stokes and Howden, 2010). Minimal soil disturbance and a high soil cover all year round are of prime importance to protect soil environment at conditions of climate change (Routschek et al., 2014). The challenge may be growing catch crops. Catch crops are crops grown in a period between the two main crops. Catch crops are valuated mainly for reduction of erosion risk, enriching soil by organic matter and reduction of nitrate leaching (Rinnofner et al., 2008). Soil organic matter is an important attribute of soil quality that affects soil aggregation and water infiltration (Franzluebbers, 2002). Mulching can be an effective technique to reduce soil evaporation (Campiglia et al., 2011). As reported Ji and Unger (2001), use of surface mulch can result in storing more precipitation water in soil by reducing runoff. Catch crop suppress weed infestation (Poggio, 2005), diseases (Caner and Tuncer, 2001) and pests (Murakami et al., 2000). Weather conditions in a given year are important in terms of achieving the aims of catch crops growing. Lack of water affects the soil moisture conditions and subsequent production capabilities of catch crops (Brant et al., 2009).

MATERIALS AND METHODS

Field experiment was conducted in the field experimental station in Zabcice (South Moravia, Czech Republic) in maize production area on clay loamy fluvisol. Maize production area belongs to the warmest and driest regions in the Czech Republic (average annual precipitation is 480 mm and average annual temperature is 9.2 °C). Ten kinds of catch crops were included to the experiment in the years 2009 - 2014: *Sinapis alba, Raphanus sativus v. oleifera, Phacelia tanacetifolia, Fagopyrum esculentum, Secale cereale v. multicaule, Panicum miliaceum, Crambe abyssinica, Malva verticillata, Phalaris canariensis, Carthamus tinctorius.* Stands of catch crops were established in August after harvest of winter wheat. Catch crops were left on the ground till spring.

RESULTS

Results of fresh matter and dry matter of catch crops are shown in the following table for the period 2009 – 2014. The highest yield of catch crops was recorded in 2012 and 2013. The lowest biomass production was reached in 2009. It was available 150 – 165 mm of rainfall from August to November in 2012 and 2013 and sum of daily temperatures amounted 1632 °C in 2012 and 1524 °C in 2013. Timing of the rainfall and temperature caused formation of sufficient amount of catch crops biomass during the growing season catch crops.

Yield of catch crops ranged from 6.30 $t.ha^{-1}$ to 25.80 $t.ha^{-1}$ of fresh matter and from 0.78 $t.ha^{-1}$ to 3.65 $t.ha^{-1}$ of dry matter in 2012. The highest yield of more than 25 $t.ha^{-1}$ of fresh matter had *Phacelia tanacetifolia, Crambe abyssinica* and *Raphanus sativus v. oleifera* and the lowest yield of fresh matter *Phalaris canariensis.* The highest yield of dry matter had *Fagopyrum esculentum* (3.65 $t.ha^{-1}$ dry matter), *Crambe abyssinica* (2.90 $t.ha^{-1}$ dry matter), *Phacelia tanacetifolia* (2.80 $t.ha^{-1}$ dry matter) and the lowest amount of dry matter had *Phalaris canariensis*. The yield of catch crops ranged from 1.08 $t.ha^{-1}$ to 21.44 $t.ha^{-1}$ of fresh matter and from 0.22 to 3.70 $t.ha^{-1}$ of dry matter in 2013. The highest yield of fresh matter belonged *Phacelia tanacetifolia* and the lowest yield *Panicum miliaceum.* The highest yield of dry matter had *Crambe abyssinica* and the lowest yield *Panicum miliaceum*. Conversely in 2009, August and September were dry to very dry months. Low rainfall negatively influenced yields of catch crops. Catch crops such as *Fagopyrum esculentum, Secale cereale v. multicaule, Panicum miliaceum, Malva verticillata, Phalaris canariensis, Carthamus tinctorius* did not create any biomass in the given year. Production of biomass was recorded only at *Phacelia tanacetifolia* (9.64 $t.ha^{-1}$ fresh and 1.57 $t.ha^{-1}$ dry matter), *Crambe abyssinica* (6.82 $t.ha^{-1}$ fresh and 1.12 $t.ha^{-1}$ dry matter), *Sinapis alba* (4.62 $t.ha^{-1}$ fresh and 0.77 dry matter) and *Raphanus sativus v. oleifera* (3.63 $t.ha^{-1}$ fresh and 0,60 $t.ha^{-1}$ dry matter) in 2009.

Sinapis alba, Raphanus sativus v. oleifera, Phacelia tanacetifolia and *Crambe abyssinica* reached regularly the highest yields of biomass in the observed years. Lower or no yields had *Fagopyrum esculentum, Secale cereale v. multicaule, Panicum miliaceum, Malva verticillata, Phalaris canariensis* and *Carthamus tinctorius. Phacelia tanacetifolia, Crambe abyssinica, Sinapis alba* and *Raphanus sativus v. oleifera* formed biomass as the only catch crops in dry year.

Table I. Fresh and dry matter of catch crops from 2009 to 2014

Meziplodiny	2009		2010		2011		2012		2013		2014	
	Matter (t.ha^{-1})											
	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
Sinapis alba	4.62	0.77	10.09	1.82	4.99	1.13	16.50	2.50	17.38	3.16	9.14	2.04
Raphanus sativus v. oleifera	3.63	0.60	8.95	1.34	7.45	1.33	25.60	2.25	15.57	2.09	11.94	1.70
Phacelia tanacetifolia	9.64	1.57	11.73	1.83	6.15	1.22	25.80	2.80	21.44	2.49	13.75	1.87
Fagopyrum esculentum	0.00	0.00	7.23	2.35	1.15	0.64	9.30	3.65	4.55	1.09	6.55	1.98
Secale cereale v. multicaule	0.00	0.00	1.45	0.50	2.02	0.54	7.30	1.40	8.90	1.92	4.40	1.13
Panicum miliaceum	0.00	0.00	0.84	0.19	1.52	0.89	9.80	1.98	1.08	0.22	1.71	0.31
Crambe abyssinica	6.82	1.12	15.14	2.60	6.15	1.19	25.70	2.90	19.47	2.59	10.32	1.76
Malva verticillata	0.23	0.04	7.21	1.16	4.03	0.88	19.70	2.25	9.03	1.33	5.62	0.81
Phalaris canariensis	0.00	0.00	0.47	0.14	0.34	0.14	6.30	0.78	8.88	1.16	2.69	0.61
Carthamus tinctorius	0.00	0.00	1.95	0.43	4.29	0.63	15.50	1.53	19.14	3.70	9.12	1.45
Average	2.49	0.41	6.51	1.24	3.81	0.86	16.15	2.20	12.54	1.98	7.52	1.37

Tabule II. Precipitation and temperature from 2009 to 2014

Month/year	Precipitation (mm)							Temperature (°C)						
	2009	2010	2011	2012	2013	2014	norm.61-90	2009	2010	2011	2012	2013	2014	norm.61-90
August	29.6	75.8	42.4	43	43.6	113.6	54.3	21.1	19.3	20.5	21.1	20.3	17.9	18.6
September	24.7	57.8	31.1	40.2	63.2	116.2	35.5	17.2	13.7	17.1	16.2	13.9	15.6	14.7
October	21.2	10.4	22.6	49.2	35.2	46.4	31.8	8.9	7.3	9.3	9.4	10.1	11,5	9.5
November	55.4	32.8	1.6	19.4	20.4	29.2	36.8	5.7	6.7	2.5	6.5	5.3	7.5	4.1

This coincides with Brant et al. (2009) lack of water affects the soil moisture conditions and subsequent production capabilities of catch crops. Growth of catch crops was limited by water and temperature. As reported Brant et al. (2009) weather conditions in a given year are important in terms of achieving the aims of catch crops growing. The family *Brassicaceae* and *Phacelia tanacetifolia* were suitable in term yield certainty and thus achieving of objectives of growing catch crops in the place which is one of the warmest and driest regions in the Czech Republic even in a dry year.

CONCLUSION

Production of catch crops is important for achieving the aims of catch crops which is limited by water and temperature. *Sinapis alba, Raphanus sativus v. oleifera, Phacelia tanacetifolia* and *Crambe abyssinica* reached regularly the highest yields of biomass in the observed years. Lower or no yields had *Fagopyrum esculentum, Secale cereale v. multicaule, Panicum miliaceum, Malva verticillata, Phalaris canariensis* and *Carthamus tinctorius.* Yield certainty had only *Sinapis alba, Raphanus sativus v. oleifera, Phacelia tanacetifolia* and *Crambe abyssinica* in dry years. The Familia *Brassicaceae* and *Phacelia tanacetifolia* were suitable in term yield certainty and thus achieving the aims of growing catch crops in the place which is one of the warmest and driest regions in the Czech Republic even in a dry year.

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