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EFFECTS OF CULTURE CONDITIONS ON THE GROWTH AND MORPHOLOGY OF 20 STRAINS OF *Drechslera avenae* (EIDAM) SCHARIF

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A b s t r a c t

Growth and sporulation of 20 single-spore isolates of *Drechslera avenae* grown on different agar media were investigated at 24°C and 11°C. Four different agar media were used – water agar (WA, 20 g agar x l^{-1}), maltose-peptone agar (MPA, 20 g maltose from Difco, 2.5 g peptone, 20 g agar x l^{-1}), potato-dextrose agar (PDA, from Difco, 39 g x l^{-1}), and rye agar (RA). The isolates were evaluated in respect of growth, colony colour, and formation of morphological structures.

The study showed differences between isolates in respect of colony growth, depending on culture conditions. Comparing macroscopic features of all *D. avenae* isolates tested, three groups of strains formed equal colonies and four individual strains were separated. Generally, most strains, except strains number: 2, 4, 7, 9, 10, 13 and 17, grew faster on all agar media at 24°C than at 11°C. In case of *D. avenae* isolates, hyphal growth was the fastest on MPA medium and the slowest on WA. All strains investigated produced typical conidiophores and conidia both at 24°C and 11°C, but at 24°C earlier sporulation was observed. MPA and RA were the best media for the sporulation of *D. avenae* strains. Sporulation of this species was the latest on WA.

Key words: *Drechslera avenae*, strains, agar media, temperatures, growth, sporulation

INTRODUCTION

Drechslera avenae (Eidam) Scharif (syn. *Pyrenophora chaetomioides* Speg.) is a specialized pathogen infecting various species of oats (*Avena* spp.) and occasionally some grass species (Obst, 1995; Paul, 1995; Prończuk, 2000; Lângaro et al. 2001; Carmona et al. 2004). Air temperature and humidity affect mycelium growth and sporulation of *D. avenae*. In laboratory conditions, the species is able to survive a temperature of 100°C (Lângaro et al. 2001). Also light conditions are important for the growth of this fungus. Long-wave UV light plays a special role (Shaner, 1981). Conidiophores, whose basal cells develop in the parenchyma and epidermis of infected leaves, are formed after 2 days in favourable conditions, i.e. increased humidity and temperature about 20°C, with an at least 7-hour photoperiod. In contrast to conidiophores, conidia of *D. avenae* are produced in darkness, at high humidity (Obst, 1995). *Drechslera avenae* is able to produce secondary metabolites, such as: pyrenophorol, pyrenophorin, or dihydropyrenophorin (Sugawara and Strobel, 1986; Kastanias and Chrysayi-Tokousbalides, 1999; 2000). Secondary metabolites produced by *D. avenae* include also anthraquinone derivatives (Engström et al. 1993).

Many researchers point to the effects of medium, temperature, and light on growth and sporulation of *Drechslera* spp. (Teviotdale and Hall, 1975; Płażek, 1996; Czembor, 1999), but there is little information on their effects on *D. avenae.* That is why this study was aimed to assess the factors affecting the growth and sporulation of various isolates of *D. avenae* in laboratory conditions.

MATERIALS AND METHODS

In the study, monosporous cultures of 20 strains of *Drechslera avenae*, from a collection of isolates from oat grain, were used (Table 1). In the experiment, 4 types of agar media were compared, i.e. water agar (WA, 20 g agar x l^{-1}), maltose-peptone agar (MPA, 20 g maltose from Difco, 2.5 g peptone, 20 g agar x l^{-1}), potato-dextrose agar (PDA, from Difco, 39 g x l^{-1}),

and rye agar (RA) (Pilchmaier, 1988), at 11°C and 24°C. For each isolate, medium, and temperature, 4 replicates were used; each Petri dish (∅ 90 mm) was treated as a replicate. On solidified media, 5-mm discs of the analysed isolates of *D. avenae*, dissected from 10-day-old monosporous maternal cultures, were placed (Ł a c i c o w a, 1970). The colonies were cultured in a growth chamber in darkness, on MPA at 24°C. The isolates were evaluated in respect of growth, colony colour, and formation of morphological structures. Linear growth of colonies of these strains was observed for 14 days. Growth increments of mycelia were measured after 3, 5, 7, 10, 12 and 14 days of incubation. Colony diameter in each replicate was measured twice, at 90° angles. Since day 3 of growth, the presence of conidia was checked under a microscope. Results recorded after 14 days of the experiment were processed statistically by means of analysis of variance and the Tukey test (Ż u k, 1989).

RESULTS

The study showed differences between isolates in respect of colony growth, depending on culture conditions (Tables 1, 2). On the basis of macroscopic features of colonies of all the studied isolates of *D. avenae* on 4 media, 3 groups forming equal colonies and 4 strains that could not be assigned to any of them were distinguished.

Colonies of the studied isolates grew faster at 24°C than at 11°C (Fig. 1). Exceptions were strains: 2, 4, 7, 10, 13, 17 whose growth at 11°C was faster than at 24°C on some media and strain number 9 whose growth at lower temperature was faster on all the tested media. (Table 2).

Aerial mycelia grew the fastest on MPA. On PDA and RA, their growth was only slightly slower and on WA it was the slowest (Fig. 2). Strains 1, 6, 8, 14, 15, 16 and 19 were assigned to group A. After 14 days of growth at 24°C, their colony diameter reached on average on PDA, MPA, RA and WA from 87.00 mm, 85.00 mm, 79.50 mm and 80.00 mm, respectively, to 90.00 mm (Tab. 2). On PDA and MPA, after 14 days of growth, the colonies were dark grey, concentrically ringed, and velvety. The reverse was brownish-grey. On WA, the strains formed delicate brownish-grey or colourless mycelia with few coremia. In contrast, on RA the aerial mycelia of those strains were compact, felt-like, olive-green, slightly elevated in the central part of the colony. The reverse of the colony did not differ from its upperside (Fig. 3). At 11°C, after 14 days of growth, their colony diameter reached on average 69.25-90.00 mm on PDA, 74.00-89.75 mm on MPA, 67.50-90.00 mm on RA, and 71.75-87.75 mm on WA (Table 2). Colonies of strains: 1, 6, 8, 14, 15, 16 and 19, at 11°C on PDA and MPA, formed low aerial mycelia, whitish-grey, delicately concentrically ringed. On RA, the strains formed woolly whitish-grey mycelia. The reverse of the colonies on this medium type was grey. On WA, the strains of this group formed submerged mycelia, while aerial mycelia were greatly reduced, delicate, whitish-grey, with whitish coremia. The underside of the colonies on that medium was colourless.

Strains 2, 7, 11 and 20 were assigned to group B. After 14 days of growth at 24°C, their colony diameter reached on average on PDA, MPA, RA and WA from: 69.00 mm, 84.00 mm, 76.25 mm and 82.00 mm, respectively, to 90 mm (Tab. 2). At 24°C, on PDA, MPA and RA, they formed olive-green mycelia, with numerous whitish-grey and beige coremia. The colony underside did not differ from its upperside. In contrast, on WA the strains formed fluffy brownish mycelia, with delicate hyphae and white coremia (Fig. 4). At 11°C, after 14 days of growth, colonies of strains 2, 7, 11 and 20 reached on average 62.50-90.00 mm in diameter on PDA, 87.75-90.00 mm on MPA, 85.75-90.00 mm on RA, and 60.50-85.00 mm on WA (Tab. 2). On PDA, MPA and RA, the strains formed low woolly mycelia, white to light grey. On WA, colonies of strains of this group formed greyish-white mycelia with delicate hyphae. The reverse of the colonies was grey, on all the analysed media.

Group C was composed of strains: 3, 5, 10, 17 and 18. After 14 days of growth at 24°C, their colony diameter on PDA, MPA, RA and WA reached on average from: 74.00 mm, 84.50 mm, 82.50 mm and 75.50 mm, respectively, to 90 mm (Tab. 2). At 24°C, colonies of the studied strains on PDA, MPA and RA did not differ. They formed woolly aerial mycelia, slightly concentrically ringed, greyish-white. The reverse of the colonies of group C strains on those media was dark grey. On WA, the strains formed aerial mycelia with delicate dark grey hyphae and white coremia. The reverse of the colonies did not differ from its upperside (Fig. 5). At 11°C, the diameter of colonies of the strains of group C reached on average 81.50-90.00 mm on PDA, 50.75-90.00 mm on MPA, 76.00-89.25 mm on RA, and 66.00-87.00 mm on WA (Tab. 2). At 11°C, on PDA, MPA and RA, the strains formed whitish-grey aerial mycelia, slightly concentrically ringed, darker at the centre on PDA. On RA, colony margin was brown. On 3 of the compared media, colonies were characterized by a dark grey reverse. On WA, the strains formed delicate, transparent mycelia, whitish-grey, with a colourless reverse. Colonies of strain 9 grew slowly at 24°C on PDA, MPA and RA. After 14 days of growth, their colony diameter

reached on average 64.25 mm on PDA, 57.50 mm on MPA, 27.00 mm on RA, and 48.75 mm on WA (Table 2). This strain formed woolly aerial mycelia, light grey on PDA and MPA, and dark grey with light grey margins on RA. On RA, strain 9 produced an orange-brown pigment, penetrating into the medium. The underside of the colony was brownish-grey. On WA, the strain formed delicate whitish-grey mycelia, with a colourless reverse (Fig. 6). At 11°C, colonies of strain 9 after 14 days of growth reached on average 79.50 mm in diameter on PDA, 77.50 mm on MPA, 87.00 mm on RA, and 78.50 mm on WA (Tab. 2). On PDA and MPA, strain 9 formed whitish-grey mycelia. The centre of the colony was grey on MPA and dark grey on PDA. On RA, this strain formed light grey mycelia. On PDA, MPA and RA, the reverse of colonies was dark grey. On WA, the strain formed delicate, whitish-grey mycelia, with a colourless reverse. After 14 days of growth at 24°C, strain 13 on average formed colonies of 8.25 mm in diameter on PDA, 25.50 mm on MPA, 25.00 mm on RA, and 27.25 mm on WA (Tab. 2). On PDA, MPA and RA the strain formed irregular colonies, greyish-white, concentrically ringed, with dark brown margins. On RA, strain 13 produced an orange-brown pigment penetrating into the medium. On WA, the strain was characterized by mycelia with delicate white hyphae. On this medium, the reverse of the colonies was colourless. On the other media, this strain was characterized by a grey reverse (Fig. 7). At 11°C, after 14 days of growth, colonies of strain 13 reached on average 28.00 mm in diameter on PDA, 31.50 mm on MPA, 18.50 mm on RA, and 8.25 mm on WA (Tab. 2). On PDA and MPA, colonies of this strain formed low aerial mycelia, woolly, whitish-grey, with a darker centre. On RA, the strain formed dark grey mycelia, with a visible orange-brown pigmentation in the medium. On those 3 media, the reverse of the colonies was dark grey. On WA, this isolate formed delicate mycelia with grey hyphae, and radially arranged whitish coremia. Strain 4 at 24°C grew much slower on PDA and RA. After 14 days of growth on those media, colonies of strain 4 reached on average 24.25 mm and 35.00 mm in diameter, respectively. On RA, this strain released an orange-brown pigment into the medium. On MPA, after 14 days of growth, its colonies reached 66.00 mm in diameter. On this medium, the strain formed irregular colonies, black at the centre. Colonies of strain 4, after 14 days of growth on WA, reached on average 51.00 mm in diameter (Tab. 2). On WA, the strain was characterized by delicate submerged mycelia, dark brown with a similar reverse (Fig. 8). At 11°C, after 14 days of growth, colonies of strain 4 reached on average 35.25 mm in diameter on PDA, 62.75 mm on MPA, 44.25 mm on RA, and 50.25 mm on WA (Table 2). On PDA and MPA, the strain formed whitish-grey, concentrically ringed mycelia, but on PDA the rings were less conspicuous. On RA, the strain formed unringed colonies, olive-grey with darker margins, elevated at the centre. On WA, this strain formed mycelia with delicate dark brown hyphae. The growth of strain 4 was slightly faster at that temperature than at 24°C. Colonies of strain 12, after 14 days of growth at 24°C, reached on average 90.00 mm in diameter on all the tested media (Tab. 2). On PDA, this strain formed dark brown, unringed, compact velvety mycelia, with a dark brown reverse. On MPA, the strain was characterized by concentrically ringed, tall and fluffy mycelia, light grey to brown. On RA, this strain formed light grey mycelia, with concentrically arranged compact structures, while on WA it formed mycelia with delicate hyphae and few coremia. On PDA, the reverse of colonies was brown, on MPA and RA it was dark grey, while on WA the colony underside did not differ from its upperside (Fig. 9). At 11°C, colonies of strain 12 grew quickly. After 14 days of growth, they reached on average 86.00 mm in diameter on PDA and MPA, 90.00 mm on RA, and 85.50 mm on WA (Table 2). On PDA, MPA and RA, its colonies were concentrically ringed. On PDA, the colonies were woolly, dark grey at the centre, with whitish-grey margins. On MPA, the strain formed woolly colonies, light grey, with whitish-grey margins, while on RA the central part of colonies was composed of compact, woolly, olive-coloured mycelia, while the margins were loose and grey. On WA, this strain was characterized by beige delicate mycelia with white margins. On PDA, MPA and RA, the reverse of the colonies was brown, while colourless on WA. Statistical analysis revealed significant differences in mycelium growth between strains of *D. avenae* (Table 1). Mycelium growth of strains 4, 9 and 13 was the slowest (Table 1).

All the studied strains produced conidiophores and conidia at both 24°C and 11°C, but at 24°C sporulation was observed earlier (Figs 4, 5). Differences in time of sporulation initiation were also observed between cultures on various media. Sporulation of this species was the latest on WA, and the earliest on MPA and RA. Out of the studied isolates, the latest sporulation was recorded in strains 3, 4 and 13 (Figs 10, 11).

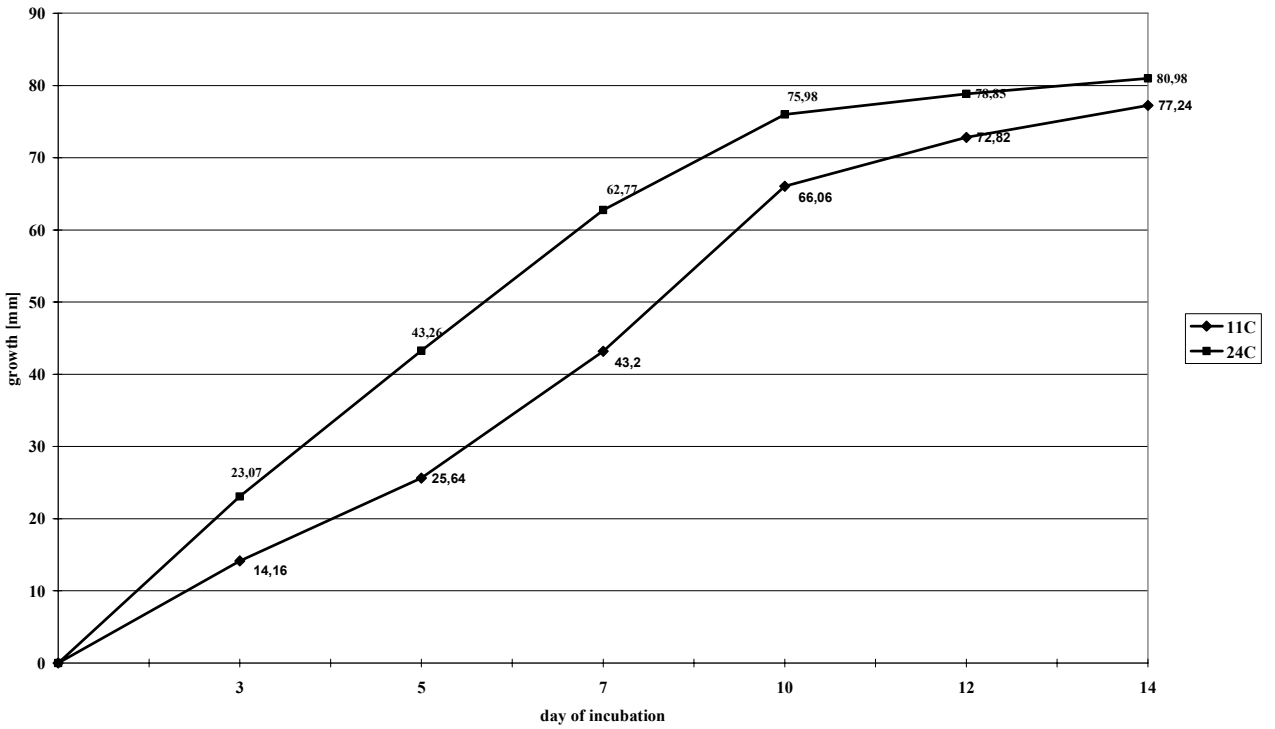

Fig. 1. Growth rate of 20 single spore isolates of *Drechslera avenae* on four substrates (PDA, MPA, WA, RA) and at two temperatures (11°C and 24°C). Means are averaged over isolates and substrate

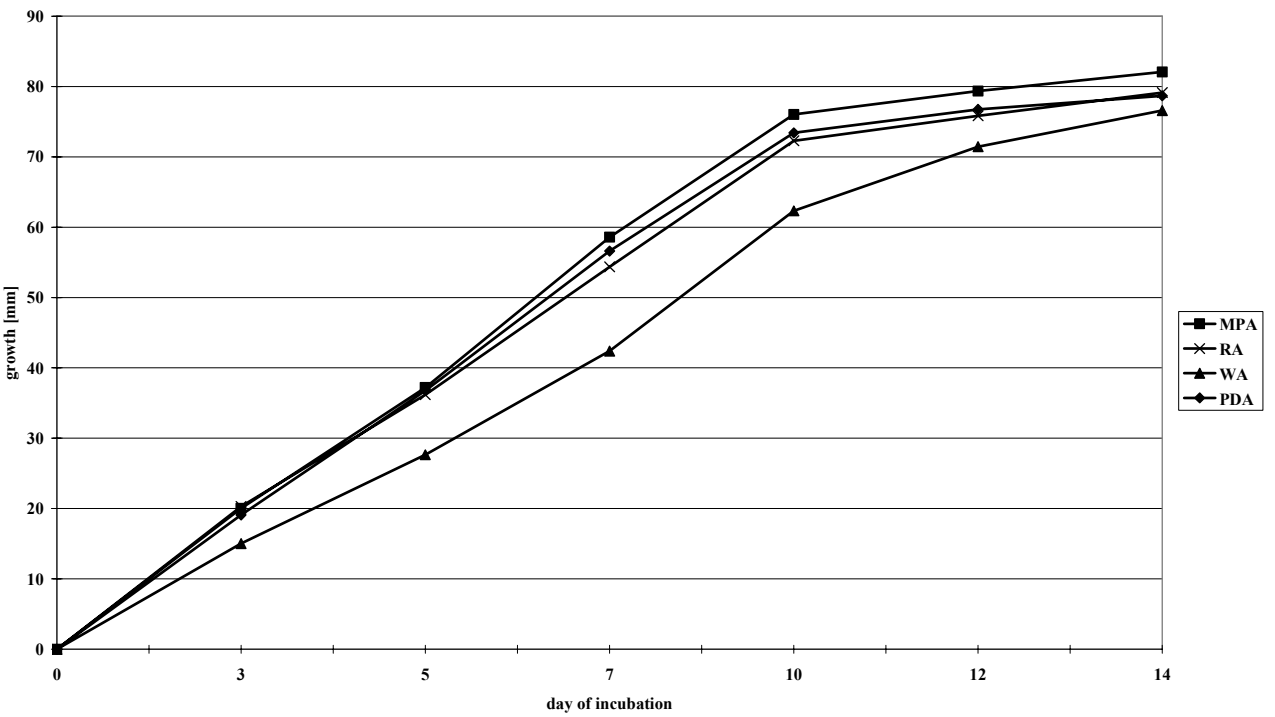

Fig. 2. Growth rate of 20 single spore isolates of *Drechslera avenae* on four substrates (PDA, MPA, WA, RA) and at two temperatures (11°C and 24°C). Means are averaged over isolates and temperatures

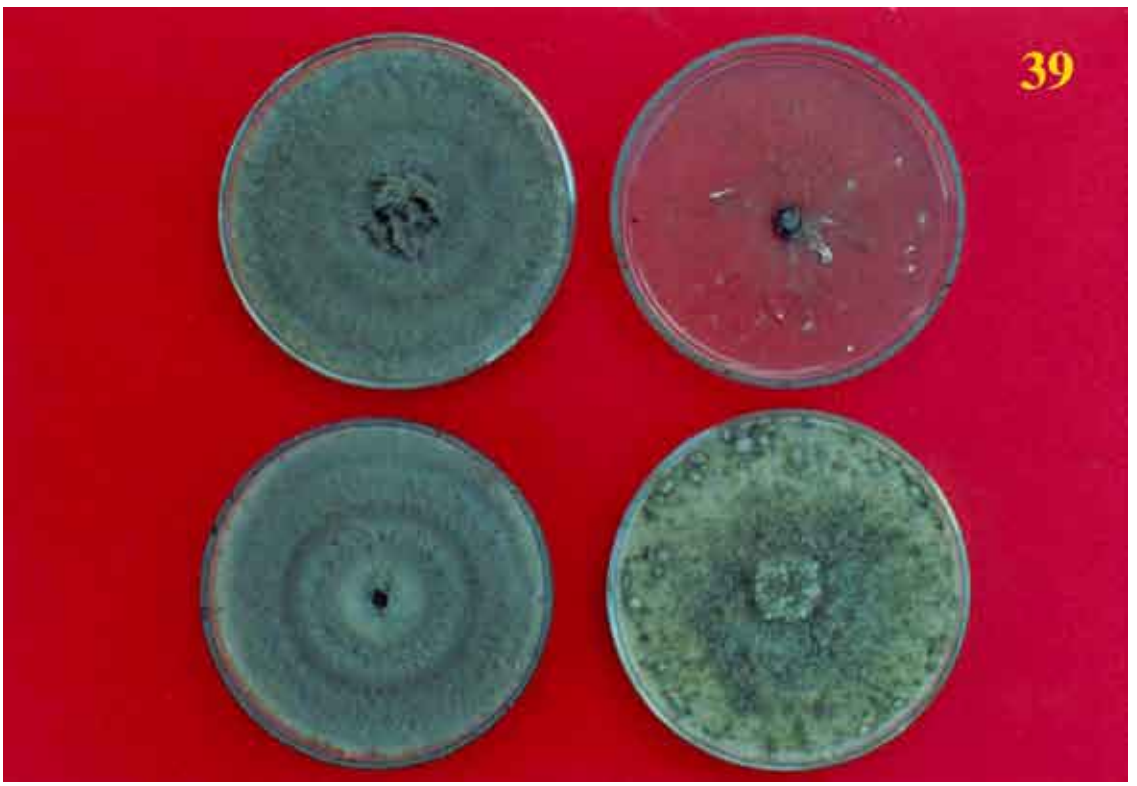

Fig. 3. Fourteen-day-old colonies of *Drechslera avenae* strains from group A on PDA, MPA, WA and RA medium at 24°C

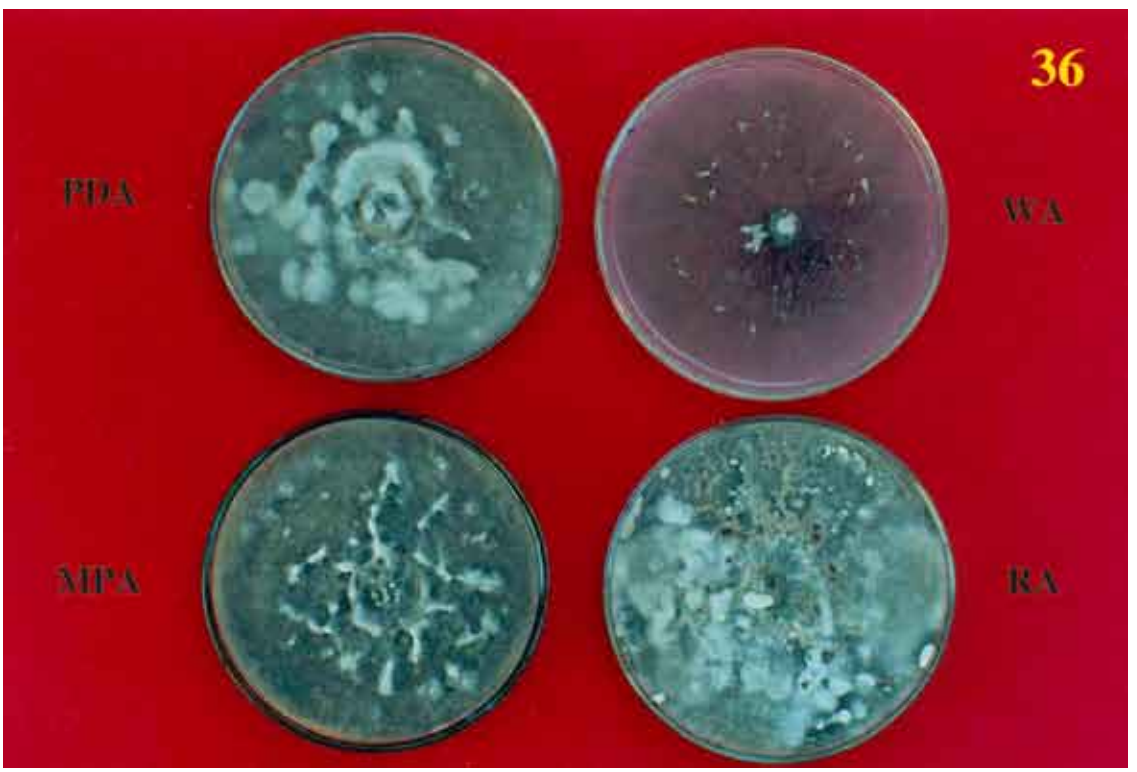

Fig. 4. Fourteen-day-old colonies of *Drechslera avenae* strains from group B on PDA, MPA, WA and RA medium at 24°C

Fig. 5. Fourteen-day-old colonies of *Drechslera avenae* strains from group C on PDA, MPA, WA and RA medium at 24°C

Fig. 6. Fourteen-day-old colonies of *Drechslera avenae* strain 9 on PDA, MPA, WA and RA medium at 24°C

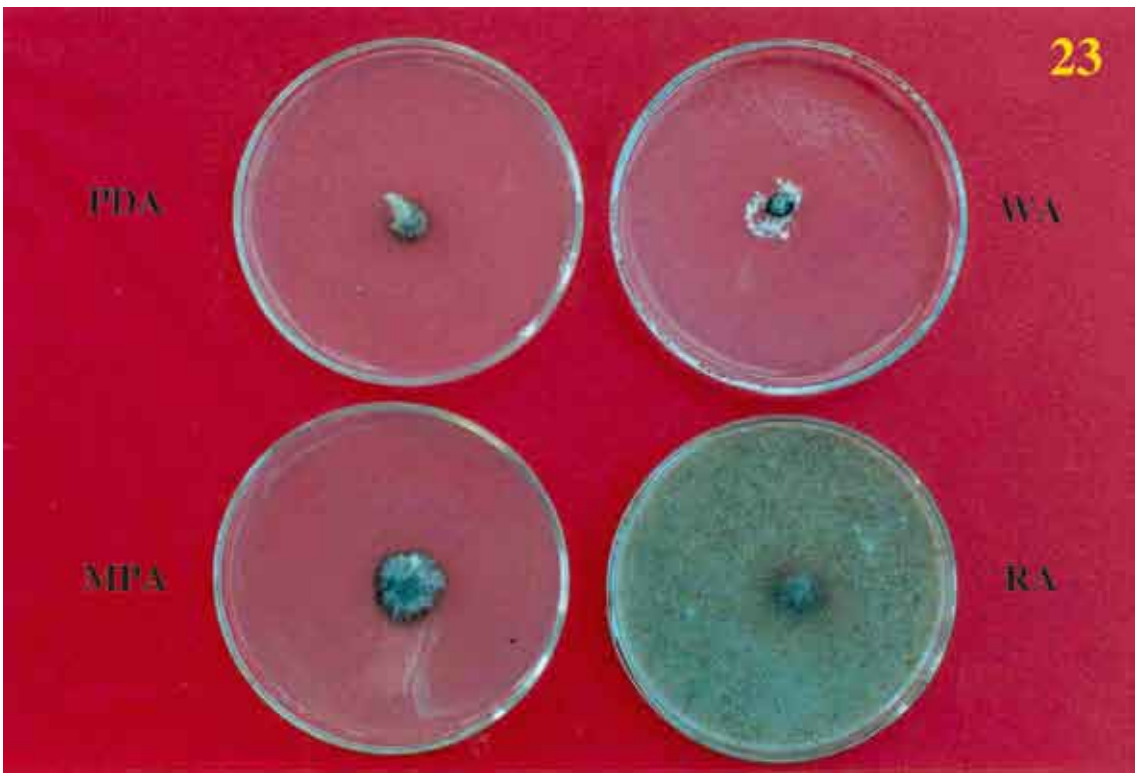

Fig.7. Fourteen-day-old colonies of *Drechslera avenae* strain 13 on PDA, MPA, WA and RA medium at 24ºC

Fig. 8. Fourteen-day-old colonies of *Drechslera avenae* strain 4 on PDA, MPA, WA and RA medium at 24ºC

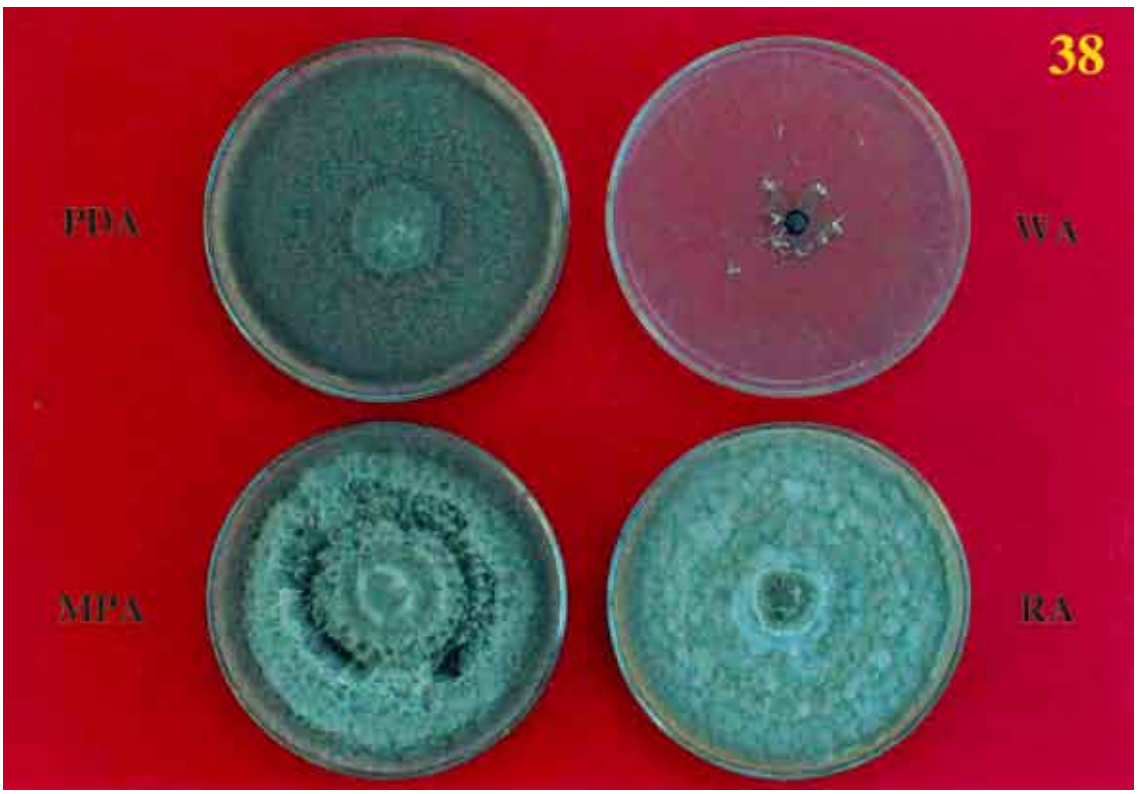

Fig. 9. Fourteen-day-old colonies of *Drechslera avenae* strain 12 on PDA, MPA, WA and RA medium at 24°C

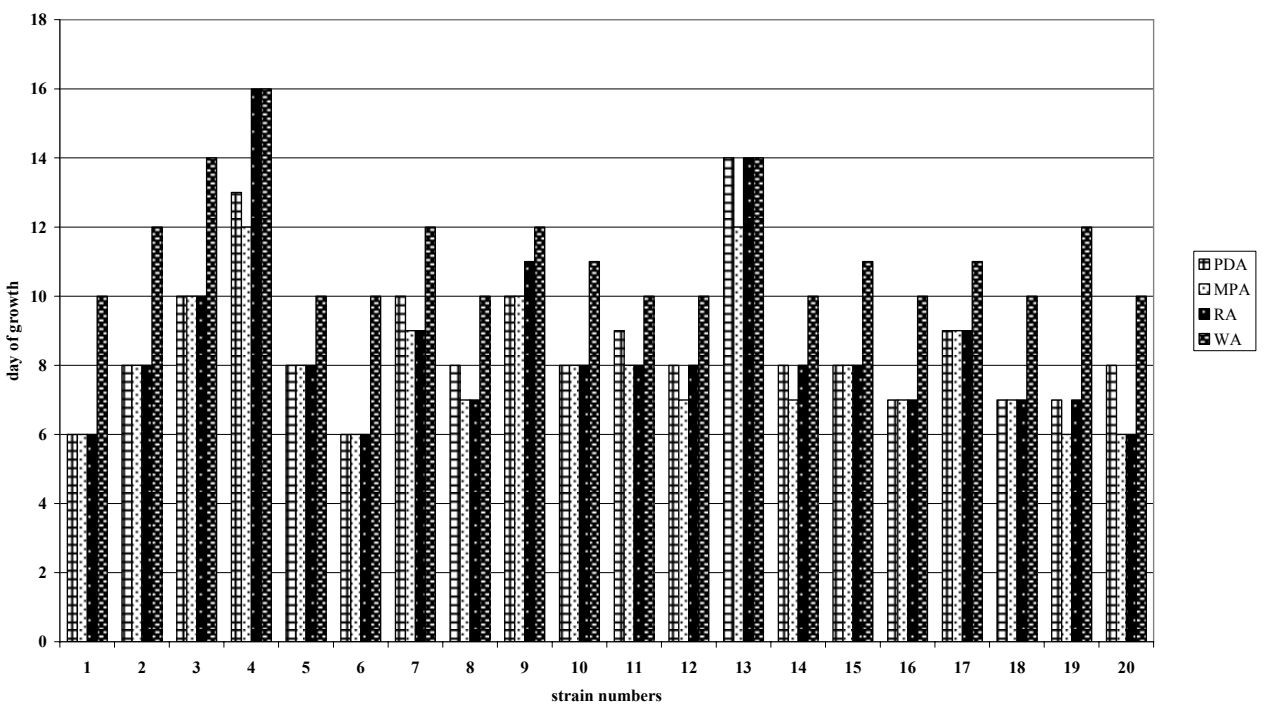

Fig. 10. Sporulation of 20 strains of *D. avenae* on four substrates (PDA, MPA, RA and WA) at 24°C

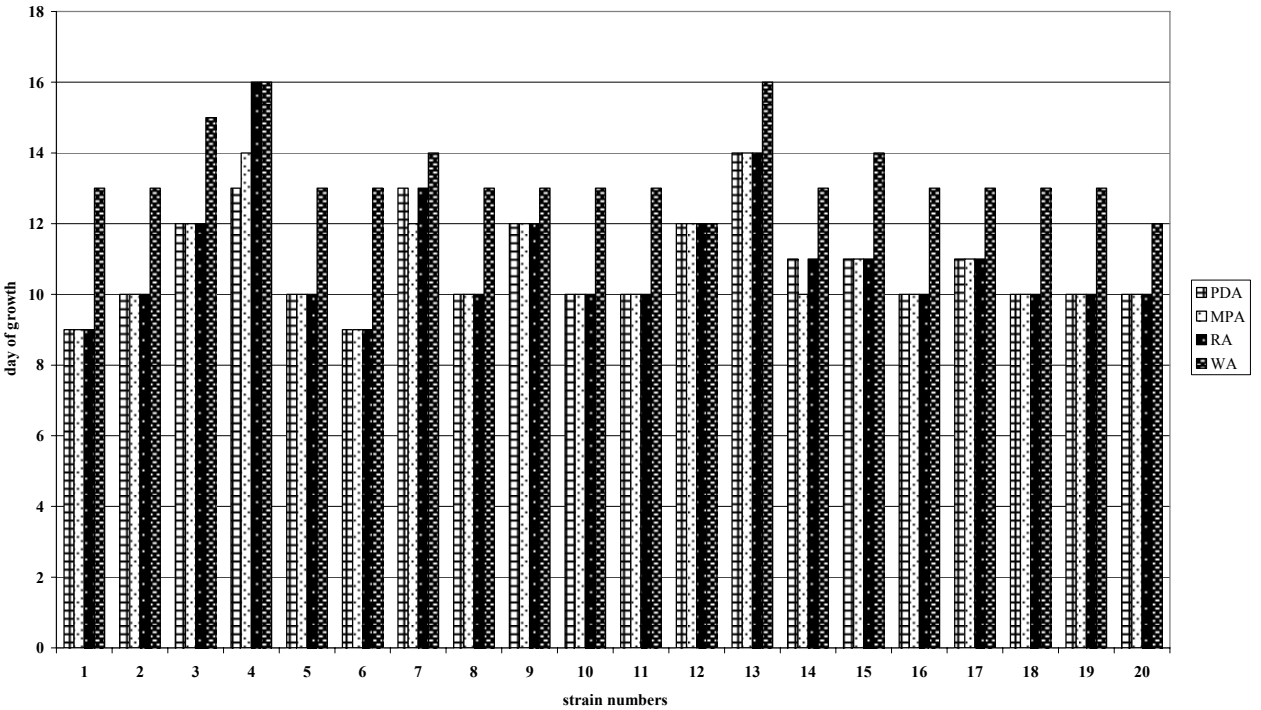

Fig. 11. Sporulation of 20 strains of *D. avenae* on four substrates (PDA, MPA, RA and WA) at 11°C

Table 1.

The influence of medium type and temperature on colony diameter of 20 strains of *Drechslera avenae* analysed

Number of strain	Colony diameter [mm]					
	Colony age					
	3 days	5 days	7 days	10 days	12 days	14 days
1	18.59^{de*}	35.12^{efgh}	53.47^{de}	77.66^{efg}	82.97^{efgh}	85.88^{efghi}
2	19.31^{def}	40.09^{ijk}	57.25^{ef}	74.34^{de}	76.75^{de}	79.87^{de}
3	13.72^{b}	31.56^{bc}	49.19^{cd}	76.31^{def}	84.84^{fgh}	86.94^{ghi}
4	15.06^{bc}	27.47^{b}	34.87^{b}	41.44^{b}	43.94^{b}	46.09^{b}
5	20.00^{efg}	40.97^{k}	64.53^{g}	83.43^{gh}	83.53^{efgh}	87.41^{ghi}
6	14.84^{b}	32.03^{cde}	53.09^{de}	78.37^{efgh}	83.69^{efgh}	85.69^{efghi}
7	17.96^{cd}	34.03^{efg}	52.84^{de}	74.12^{de}	77.81^{def}	80.47^{def}
8	20.00^{efg}	36.69^{ghi}	56.19^{ef}	78.94^{efgh}	85.37^{gh}	89.34^{hi}
9	14.53^{b}	29.28^{bc}	43.66^{c}	58.81^{c}	63.16^{c}	66.09^{c}
10	17.19^{cd}	36.06^{fghi}	54.22^{def}	74.19^{de}	77.69^{def}	80.47^{def}
11	22.81^{ij}	37.47^{ghijk}	57.97^{ef}	79.37^{efgh}	83.94^{efgh}	87.62^{ghi}
12	21.22^{fgh}	37.66g^{hijk}	64.69^{g}	84.84^{h}	89.34^{h}	89.94^{i}
13	7.59^{a}	9.37^{a}	12.34^{a}	15.66^{a}	16.72^{a}	20.47^{a}
14	24.34^{j}	40.81^{jk}	58.78^{efg}	73.75^{de}	77.56^{def}	81.91^{defg}
15	21.78^{hi}	36.91^{ghij}	53.28^{de}	70.16^{d}	77.72^{def}	83.28^{defgh}
16	20.00^{efg}	34.84^{efgh}	53.37^{de}	70.56^{d}	79.09^{defg}	86.03fghi
17	21.37^{fgh}	37.00^{ghij}	56.56^{ef}	69.34^{d}	74.72^{d}	78.34^{d}
18	21.62^{hi}	38.75^{hijk}	64.37^{g}	81.81^{fgh}	86.59^{h}	89.37^{hi}
19	21.66^{hi}	37.22^{ghijk}	58.97^{efg}	78.41^{efgh}	85.72^{gh}	89.09^{hi}
20	18.94^{de}	35.62^{fgh}	60.03^{fg}	78.81^{efgh}	85.59^{gh}	87.94^{ghi}

• – Means in columns followed by the same letter do not differ significantly at $p \leq 0.05$

Table. 2

The colony diameter of 20 strains of *Drechslera avenae* after 14 days of growth at 24°C and 11°C on four different agar media

Number of strain	Colony diameter [mm]									
	Medium type									
	Temp. 24°C					Temp. 11°C				
	PDA	MPA	WA	RA	LSD when $p \leq 0,05$	PDA	MPA	WA	RA	LSD when $p \leq 0,05$
1	90.00	90.00	80.00	89.00	12.31	88.25	88.50	75.25	85.50	5.83
2	69.00	84.00	82.00	90.00	14.17	64.75	89.25	74.75	85.75	9.01
3	89.50	90.00	89.00	90.00	6.01	88.25	88.75	73.00	87.50	8.05
4	24.25	66.00	51.00	35.00	15.82	35.25	62.75	50.25	44.25	12.17
5	90.00	90.00	85.75	90.00	6.14	90.00	89.50	74.75	89.25	9.63
6	90.00	85.00	88.25	90.00	7.02	90.00	74.00	78.25	90.00	7.34
7	90.00	90.00	84.50	76.25	8.11	62.50	90.00	60.50	90.00	7.50
8	90.00	90.00	88.25	90.00	3.41	90.00	89.75	87.75	90.00	3.07
9	64.25	57.50	48.75	27.00	10.63	79.50	77.50	78.50	87.00	13.18
10	74.00	87.50	88.00	86.00	9.97	89.50	50.75	80.00	88.00	8.93
11	90.00	88.00	85.00	90.00	6.05	87.25	87.75	85.00	88.00	3.74
12	90.00	90.00	90.00	90.00	n.s	86.00	86.00	85.50	90.00	1.13
13	8.25	25.50	27.25	25.00	3.86	28.00	31.50	8.25	18.50	9.23
14	87.00	90.00	89.50	79.50	6.15	73.25	81.25	87.25	67.50	8.75
15	89.50	90.00	90.00	90.00	0.84	69.25	88.00	76.25	75.25	9.99
16	90.00	90.00	88.25	89.50	2.01	87.00	84.25	71.75	87.50	7.06
17	77.00	84.50	75.50	82.50	6.03	81.50	83.75	66.00	76.00	9.17
18	90.00	90.00	90.00	90.00	n.s	89.00	90.00	87.00	89.00	3.04
19	90.00	90.00	88.50	90.00	3.82	90.00	89.50	84.75	90.00	6.31
20	90.00	90.00	90.00	90.00	n.s	90.00	90.00	75.50	88.00	10.71
LSD when $p \leq 0.05$	31.75	24.16	25.51	26.71		25.07	28.13	29.47	26.32	

n.s – not significant

DISCUSSION

The analyses showed that the studied strains of *D. avenae*, isolated from oat grain grown in southeastern Poland, are not morphologically homogeneous. Irrespective of medium type, the temperature of 24°C proved to be favourable for the growth and sporulation of most strains of *D. avenae*. For *D. poae* (Czembor, 1999), *D. dictyoides* (Vargas and Wilcoxon, 1969) and *D. graminea* (Teviotdale and Hall, 1975), a lower temperature, i.e. about 18°C, is favourable for sporulation. Among the studied strains of *D. avenae*, three groups of strains A, B, C were distinguished and 4 single strains that could not be assigned to any group. The detailed investigations concerning analysis of anthraquinone compounds of strain No 1 from group A showed the ability of this strain to produce cynodontin and helminthosporin (Cegiełko, 2006). Strains from individual groups differed in colony appearance, growth rate, time of sporulation initiation, and ability to produce an orange-brown pigment, penetrating into the medium, at both 24°C and 11°C. Similarly, in various strains of *D. graminea,* variation in morphological features and growth rate was reported by Jawhar et al. (2000).

The agar media PDA, MPA and RA were favourable for early production of conidia: after 8 days of culture at 24°C, and after 11 days at 11°C, in most of the studied strains of *D. avenae.* In the compared culture conditions, most of the strains produced conidia on MPA. The presence of sugars (maltose or glucose) in the medium accelerates the growth and development of hyphae as well as production of conidia by

D. avenae, which is confirmed by poor sporulation and formation of delicate mycelia by strains grown on WA. Similarly, WA used as a medium for culture of *D. poae* was not favourable for its growth and sporulation (Czembor, 1999). MPA can be recommended for culture of *D. avenae* because of its intensive growth and sporulation on this medium. In comparison with other sugars, maltose proved to be a much better source of carbon, stimulating also the sporulation of *D. poae, D. rostrata*, *D. sorghicola*, *D. cynodontis*, *D. hawaiiensis* and *D. australiensis* (Kafi and Tarr, 1966 according to Czembor, 1999; Czembor 1999). The growth of various fungal species, including *D. avenae*, can be affected by sugar concentration in the medium. *D. avenae* shows a high tolerance to changes in glucose concentration in the medium, and only when its concentration reaches 25%, fungal growth is nearly completely inhibited (Płażek, 1996).

CONCLUSIONS

1. Temperature 24şC turned out to be fawourable for growth and sporulation of *Drechslera avenae.*
2. The most favourable medium for culture of *Drechslera avenae* was MPA.
3. The presence of sugars in the medium, maltose (MPA) or glucose (PDA), accelerates the growth and development of hyphae as well as production of conidia by *Drechslera avenae.*
4. Among the population of *Drechslera avenae* strains, there occurs the differentiation of morphological features, growth rate and production of pigments penetrating into the medium.

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Wpływ warunków hodowli na wzrost i morfologię 20 szczepów *Drechslera avenae* (Eidam) Scharif

S t r e s z c z e n i e

W badaniach oceniano wzrost i zarodnikowanie 20 izolatów *Drechslera avenae* na różnych podłożach w temp. 24°C i 11°C. Uwzględniono cztery rodzaje pożywek agarowych: wodny agar (WA, 20 g agaru $\times l^{-1}$), maltozowa z dodatkiem peptonu (MPA, 20 g maltozy - Difco, 2.5 g peptonu, 20 g agaru l^{-1}), glukozowo – ziemniaczana (PDA, Difco, 39 g $\times$ l^{-1}), żytnia (RA). Izolaty były oceniane na podstawie wzrostu, barwy kolonii oraz tworzenia struktur morfologicznych.

Przeprowadzone badania wykazały zróżnicowanie we wzroście kolonii poszczególnych izolatów w zależności od warunków hodowli. Porównując cechy makroskopowe kolonii wszystkich badanych izolatów, wydzielono trzy grupy szczepów tworzące jednakowe kolonie oraz cztery pojedyncze szczepy. Generalnie większość szczepów, z wyjątkiem szczepów nr: 2, 4, 7, 9, 10, 13 i 17 wzrastało szybciej na wszystkich podłożach hodowlanych w temperaturze 24°C, niż 11°C.

Najszybszy wzrost grzybni powietrznej szczepów *D. avenae* obserwowano na pożywce MPA, zaś najsłabszy na pożywce WA. Wszystkie badane szczepy tworzyły konidia i konidiofory zarówno w temp. 24°C, jak i 11°C, przy czym w temperaturze 24°C obserwowano wcześniejsze zarodnikowanie. Podłoża MPA i RA sprzyjały zarodnikowaniu szczepów *D. avenae.* Najwolniej gatunek ten zarodnikował na pożywce WA.