AERIAL APPLICATION OF COVER CROPS INTO CORN AND SOYBEAN

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Interseeding cool-season grasses: annual ryegrass (*Lolium multiflorum*); barley (*Hordeum vulgare*) or winter rye (*Secale cereal*) alone or in combination forage legumes or radish (*Raphanus sativus*) into standing row crops is an increasingly common practice in the upper mid-west for corn and soybean producers who otherwise could not grow cover crops because of insufficient time for growth if planted after harvest. Perceived soil quality benefits: species diversity and impact on the soil biological community; return of vegetative (green) biomass to soil (including roots) and enhanced over-winter soil cover are all responsible for this interest and the belief that it will result in long-term improvement of crop yield and economic return (CTIC, 2013). Additional ecosystem services in this intensified system include the potential to increase infiltration and the retention of residual applied nitrogen when growing season conditions prevent corn from achieving its full yield potential. Increased infiltration is important for soil and nutrient retention as well as water capture and storage to mitigate increasing precipitation variability induced by climate change

Aerial broadcast seeding is the most common method of establishment in standing corn although industry has responded to grower demand and several equipment manufacturers are developing high capacity “high-boy” ground application equipment which could increase capacity over aerial application alone and result in greater planted acreage. This addresses a major barrier to cover crop adoption (Stockwell, 2012). Use of drop-tubes may also improve seed distribution on the soil surface improving cover crop efficacy. Aerial application offers advantages of rapid planting, frees the client’s time for other pursuits and can be done when soil conditions are unfavorable for equipment operation.

Broadcasting seed offers challenges for successful stand establishment including downslope seed movement with run-off water (Bich et al., 2014), seed predation (Wilson et al., 2014) and fluctuations in temperature and surface moisture compared to incorporated seed (Fischer et al., 2011). In Minnesota, Wilson et al. (2013) determined that adequate soil moisture was critical for stand establishment, including rainfall within a week of application. These authors also found soil temperature had no effect on germination and establishment success, but also that their model looking at soil type, moisture and temperature only accounted for 43% of the variation in cover crop biomass production. Other authors (Ball-Coelho, 1997; Feyereiesen et al., 2006; Whitmore and Schroeder, 2007; Baker and Griffis, 2009) suggest light interception by the canopy is an important determinant in cover crop performance, at least with winter rye.

Timing is critical not only to prevent yield reduction or harvest interference in the target crop but also to obtain satisfactory cover crop performance. Cover crops seeded during the Critical Weed

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Free Period (Knezevic et al., 2002) have the potential to reduce yield by competition for light, nutrients and moisture. In corn, numerous studies have reported yield reduction for early interseeding but recently Bich et al. (2014) reported no yield reduction after V5 (Ritchie et al, 1989). Data for conventional soybean is lacking, presumably because of the potential for harvest interference and seed application at leaf-yellowing provides a longer period for competition free cover crop growth compared to corn.

Common practice among aerial applicators is to time application in corn using a specific phenological indicator: stalks browned to the ear-leaf (Damon Reabe, Personal communication). Applicator experience suggests that this is a satisfactory guideline for stand establishment with our current understanding canopy light penetration and its impact on cover crop establishment, but more work is needed to improve success rates. Informal investigation has indicated that in cases of establishment failure, plants are often etiolated, suggesting insufficient light penetration of the canopy and plants succumb to a lack of moisture from underdeveloped roots. Research is needed to determine the optimum level of light reaching the soil surface for successful cover crop establishment. This would mitigate factors such as stand density, leaf architecture and plant height which influence light penetration and are independent of the phonological target currently used.

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